July 1, 1957 50 Cents

AVIATION WEEK

A McGRAW-HILL PUBLICATION

Passive Radar Uses Infrared Technique

•

First Pictures of New Utility Jets

Goodrich Full Pressure Suit

EASY GOING...

WHEN YOU GO CONVAIR METROPOLITAN 440!

Whether you're taking the twins (and all the equipment twins need) for a visit with the folks back home—or only a briefcase on a hurry-up business trip—Convair's new Metropolitan 440 makes your *going easy!* From departure to arrival, you save time and enjoy these extra comforts only on a Convair: built-in steps...ample carry-on luggage racks...and the *quietest* passenger cabin of any airliner flying today! Ask your travel agent or favorite airline to make your next flight *easy going*...on a Convair Metropolitan 440.

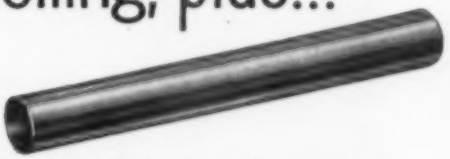
CONVAIR

A DIVISION OF GENERAL DYNAMICS CORPORATION

Now Flying: AERO O. Y., Finland; ALITALIA, Italy; ANSETT, Australia; BRANIFF, U.S.A.; CONTINENTAL, U.S.A.; DELTA, U.S.A.; EASTERN, U.S.A.; IBERIA, Spain; JAT, Jugoslavia; KARHUMAKI, Finland; LUFTHANSA, Germany; NATIONAL, U.S.A.; NIPPERI, Japan; REAL S.A., Brazil; SAS, Denmark-Norway-Sweden; SABENA, Belgium; SWISSAIR, Switzerland • **Soon to Fly:** CRUZEIRO DO SUL, Brazil

...at 40,000 ...climbing

tested for today's ceiling, plus...



As machines and man fly higher and higher, materials like the thin-wall tubing made by Western Pneumatic Tube Company must be able to withstand greater extremes of vibration, temperature and pressure.

Thin-wall metallic tubing, available in many types of metals, is made in diameters from ½" to 8", wall thicknesses from .002" to .050", and is tested and approved for aircraft of today and tomorrow. A versatile product, Western Pneumatic Tube Company's tubing may be fitted to any aircraft design problem. Send for booklet giving details of product.

WESTERN

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KIRKLAND, WASHINGTON

Warehouse Distributors:
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Sales Agents:
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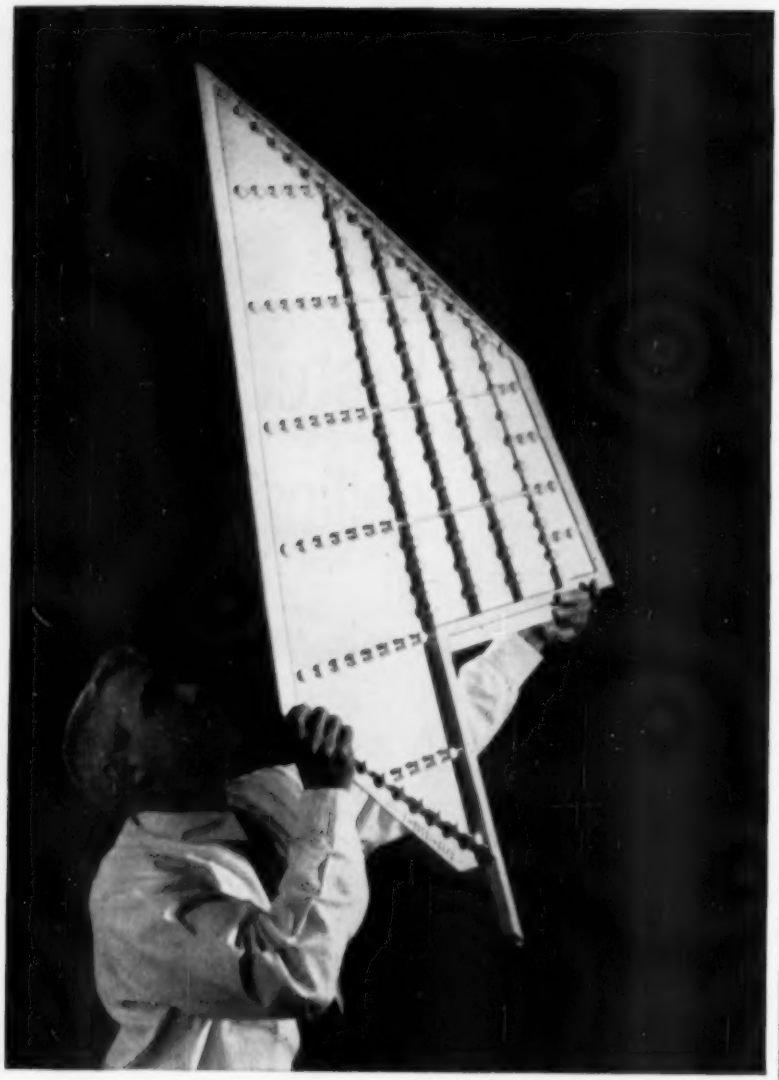

THIN-WALL magnesium casting for the Regulus missile fin produced by Dow.

QUALITY MAGNESIUM CASTINGS

for aircraft and missiles

Sand, Permanent Mold, Plaster Castings

YOU NAME THE CASTING. Dow can supply you with ordinary and extraordinary shapes or sizes. Specialized techniques rigidly maintain your standards and specifications. Heavy-wall or thin-wall, room or elevated temperature use, the best—and surest—answer to your problems is Dow magnesium castings! Contact your nearest Dow sales office for additional information. THE DOW CHEMICAL COMPANY, Foundry Sales, Bay City, Michigan.

YOU CAN DEPEND ON DOW

AVIATION CALENDAR

July 2-11—24th National Soaring Contest, Harris Hill, Elmira, N. Y.

July 6-10—Eleventh All-Women Transcontinental Air Race, from San Mateo County Airport, Carlos, Calif., to North Philadelphia Airport, Pa.

July 12-13—British Lockheed International Aerobatic Competition, the National Air Races (third round) and the King's Cup Air Race, Coventry Civil Aerodrome, Bagington, England.

July 13-19—1957 Jaycee Air Cruise, Philadelphia, Pa.-Las Vegas, Nev. Write: G. Ralph Guthrie, Air Cruise Chairman, Junior Chamber of Commerce, 121 S. Broad St., Philadelphia, Pa.

July 28—Third Annual Jaycee Air Fair, sponsored by Portland (Oregon) and Junior Chamber of Commerce, Portland International Airport.

July 31-Aug. 4—Eleventh Annual National Convention, Air Force Assn., and Airpower Panorama, Sheraton-Park and Shoreham Hotels, Washington, D. C.

Aug. 1-2—Second Annual Exiborama and First Annual National Photo Instrumentation Symposium, Society of Photographic Instrumentation Engineers, Ambassador Hotel, Los Angeles.

Aug. 5-10—National Naval Aviation Meeting, Institute of Aeronautical Sciences, U. S. Grant Hotel, San Diego, Calif.

Aug. 10-11—Midget Airplane Races, Oshkosh, Wis.

Aug. 20-22—Bendix-Scintilla International Ignition Conference, Sidney, N. Y.

Aug. 20-23—Western Electronic Show & Convention, Cow Palace, San Francisco.

Aug. 26-28—Gas Dynamics Symposium Transport Properties in Gases at High Temperatures and Pressures, Technological Institute, Northwestern University, Evanston, Ill.

Aug. 31-Sept. 1—Midget Airplane Races, Ft. Wayne, Ind.

Sept. 1-15—Sixth International Aeronautical Conference, Royal Aeronautical Society

(Continued on page 6)

AVIATION WEEK • JULY 1, 1957

Vol. 66, No. 26

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John H. Logsdon, president, (right) and Robert L. Donovan, vice-president and secretary, Interstate Airmotive, Inc., Lambert Field, St. Louis.

At Interstate Airmotive in St. Louis they found service the key to success

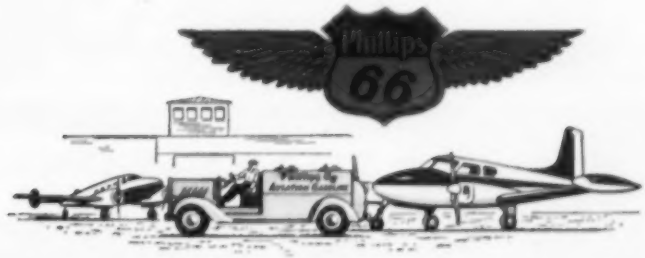
CAA-approved repair service is a feature of Interstate's operation. E. G. McEntee, line manager, at right, and F. H. Pogue, licensed A. & E. mechanic.

Phillips 66 Aviation Gasoline is used exclusively in servicing all types of aircraft.

After World War II, in which John Logsdon was an aviation cadet instructor and Robert Donovan served as a pilot in the 8th air force, these two young men purchased Interstate Airmotive. Logsdon recalls that, at the time, Interstate was a $50,000-a-year business. In 1956, Interstate grossed in excess of $1 million.

"Service, we believe, is the key to this increase in business," Mr. Logsdon said. Interstate was one of the first to offer courtesy cars to incoming pilots; and the facilities include a pilots' lounge. Interstate offers 24-hour complete line service for both commercial and private aircraft. It has one of the country's most complete radio repair shops. It offers CAA-approved repairs, charter service and hangar storage.

Interstate sells Phillips *66* Aviation Gasoline exclusively. "We felt that as a part of better service, we must supply a dependable fuel," Mr. Donovan said. "That's why we decided to service our customers' aircraft with Phillips *66* Aviation Gasoline."



AVIATION DIVISION • PHILLIPS PETROLEUM COMPANY • BARTLESVILLE, OKLAHOMA

TRANS-SONICS

REG. T. M.

PRECISION TRANSDUCERS

for measurement and control of

- **TEMPERATURE**
  −400F to +2000F
- **PRESSURE**
  0-5 to 0-5000 psi.

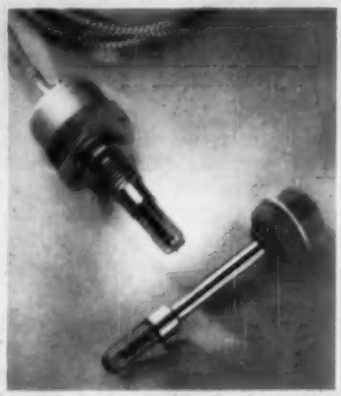
to meet strictest requirements of

- **TELEMETRY**
- **MISSILE RESEARCH**
- **AIRCRAFT CONTROL**

an example of

TRANS-SONICS ADVANCED INSTRUMENTATION

OPEN TEMPERATURE PICKUPS



The Illustrated OPEN TEMPERATURE PICK-UPS are precision platinum resistance thermometers capable of high-speed temperature measurement of gases and non-corrosive fluids. Resistance winding, supported on ceramic-insulated posts or on card, is in direct contact with environment to be measured, and can have time constants as fast as 50 milliseconds. Full-scale output voltages of 5-volts can be delivered directly to telemetry commutation circuits. Units operate over selected ranges from −320F to +750F (−200C to +400C), with accuracy better than ±1% of full scale and repeatibility of ±0.2%. Calibration Certificate giving precise 5-point calibration supplied with each unit. Stainless steel case and rugged construction withstand 1500 psia pressures, ±25 g vibration, and 60 g shocks under MIL-E-5272A. Send for Technical Bulletins 1182 and 1350.

TRANS-SONICS
INCORPORATED
Burlington, Massachusetts

AVIATION CALENDAR

(Continued from page 4)

and Institute of the Aeronautical Sciences, Folkestone and London, England.

Sept. 2-8—1957 Flying Display, Society of British Aircraft Constructors, Farnborough, England.

Sept. 3-14—11th General Assembly, International Union of Geodesy and Geophysics, in conjunction with International Geophysical Year, University of Toronto, Canada.

Sept. 9-13—Annual General Meeting, International Air Transport Assn., Madrid, Spain.

Sept. 9-13—Twelfth Annual Instrument-Automation Conference & Exhibit, Cleveland Auditorium, Cleveland, Ohio.

Sept. 13—Third Pacific Area National Meeting, American Society for Testing Materials, Sheraton-Palace Hotel, San Francisco, Calif.

Sept. 15—1957 Garden Party and Flying Display, Royal Aeronautical Society, Wisley Aerodrome, Weybridge, Surrey, England.

Sept. 26-27—Fifth Michigan Aeronautics Conference, jointly sponsored by University of Michigan Transportation Institute, Western Michigan University, and The Aero Club of Michigan, Alpena, Mich.

Oct. 1-5—National Aeronautics Meeting, Aircraft Production Forum & Aircraft Engineering Display, Hotel Ambassador, Los Angeles.

Oct. 2-4—Tenth Annual Meeting and Forum, National Business Aircraft Assn., Cosmopolitan Hotel, Denver, Colo.

Oct. 7-9—13th Annual National Electronics Conference, Chicago, Ill.

Oct. 7-10—Triennial Inspection, Lewis Flight Propulsion Laboratory, Cleveland.

Oct. 7-12—Eighth Annual Congress, International Astronautical Federation, Barcelona, Spain. For details write: IAF, 35 Lowell Rd., Concord, Mass.

Oct. 9-11—National Fall Convention, Society for Experimental Stress Analysis, El Cortes Hotel, San Diego, Calif.

Oct. 21-22—Canadian Aeronautical Institute-Institute of the Aeronautical Sciences Meeting, Montreal, Canada.

Oct. 21-23—Conference on new developments in the field of power, American Society of Mechanical Engineers, Americus Hotel, Allentown, Pa.

Oct. 24-25—Fourteenth Annual Display, Aircraft Electrical Equipment, Aircraft Electrical Society, Pan Pacific Auditorium, Los Angeles, Calif.

Oct. 28-29—Third Annual Meeting, Association of the U. S. Army, Sheraton-Park Hotel, Washington, D. C.

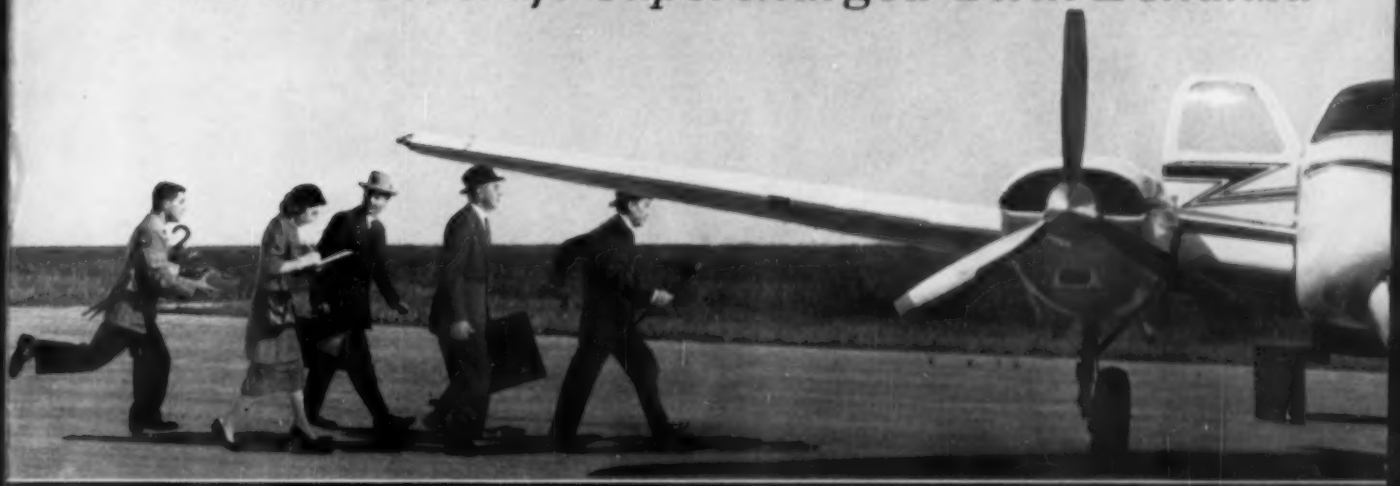
Oct. 28-30—Annual East Coast Conference on Aeronautical and Navigational Electronics, Fifth Regiment Armory, Baltimore, Md.

Oct. 28-31—National Industrial Packaging & Handling Exposition, Atlantic City Convention Hall, N. J.

Nov. 5-7—Joint Military-Industry Guided Missile Reliability Symposium (limited to those with Secret security clearance), Naval Air Missile Test Center, Pt. Mugu, Calif.

Nov. 18-29—International Air Transport Assn. Technical Conference, Miami, Fla.

business moves fast
in a Beechcraft Supercharged Twin-Bonanza



and Lear keeps it moving–weather or not!

SUPERCHARGED ENGINES give the new Twin-Bonanza more speed, greater range, and a big boost in altitude. Here is increased power to carry you more safely through weather or to rise above it. And it's here that having the finest navigational instruments really pays off. That's why the Beech factory provides LEAR equipment at your option. LEAR communications systems, automatic direction finders, omnirange receivers, marker beacon receivers, and automatic pilots are all available for this new executive Beechcraft.

LEAR

LearCal Division—3171 South Bundy Drive, Santa Monica, California
LC-43

"An infinite capacity for taking pains"

The above familiar phrase is usually given as a definition of genius. We borrow it as a job description.

The lengths to which our Quality Control people go, to insure the reliability of our complex products, are truly painstaking, and are applied equally to components we make ourselves and those we purchase from outside suppliers.

For example, consider vacuum tubes, the heart of hundreds of projects in our Electronics Division. No spot check satisfies here (even if that's all our customer specifies)—but a whole series of critical tests, including such precise evaluations as these:

Inspection of tube characteristics to rigid Stromberg-Carlson specifications—performed on special equipment which can do in a half-hour what would take days on conventional testing devices.

Inspection by X-ray, looking for deeply hidden potential faults which could cause malfunction at any time after first use.

Inspection by microscope, seeking welding faults, minute cracks in glass, and even infinitesimal loose particles inside the tube.

And tubes are only one concern. *All* components must pass similarly rigid tests, to assure operating performance, ruggedness and reliability in the completed equipment.

You can't put a price on "taking infinite pains." You *can* place your confidence in a company where this is everyday procedure.

S-C

STROMBERG-CARLSON COMPANY

A DIVISION OF GENERAL DYNAMICS CORPORATION

General Offices and Factories at Rochester, N. Y.—West Coast plants at San Diego and Los Angeles, Calif.

GD

speaking of reducing...

new

weston pneumatic pressure reducers

give you up to 1000 scfm at only 1.87 lbs.!

SPECIFICATIONS

Inlet Pressure—3000 psi
Rated Flow—Up to 75 lbs/min. (1000 SCFM)
Outlet Pressure—As required—200 to 2800 psi
Relief Pressure—115% of Outlet Pressure
Maximum Leakage—5 c.c./min standard air
Ports—½ inch tube size
Temperature Range—−65° to 180° F
Overall Dimensions—6.85 x 3.5 x 3.4 inches
Weight—1.87 lbs.

Endurance tested for 100,000 cycles. Integral bleed-down feature releases outlet pressure when inlet pressure is removed.

Weston Reducers feature close control of outlet pressure over a wide range of inlet pressures and outlet flows. Performance exceeds the requirements of specification MIL-R-8572A (Aer.). Designs are presently available with flow capacities up to 2000 SCFM! We invite your solicitation with reference to specific application.

BW weston

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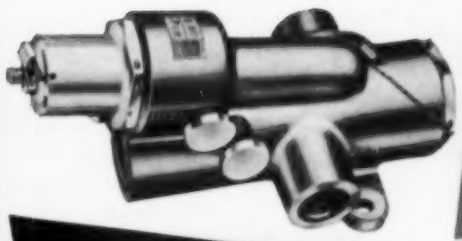
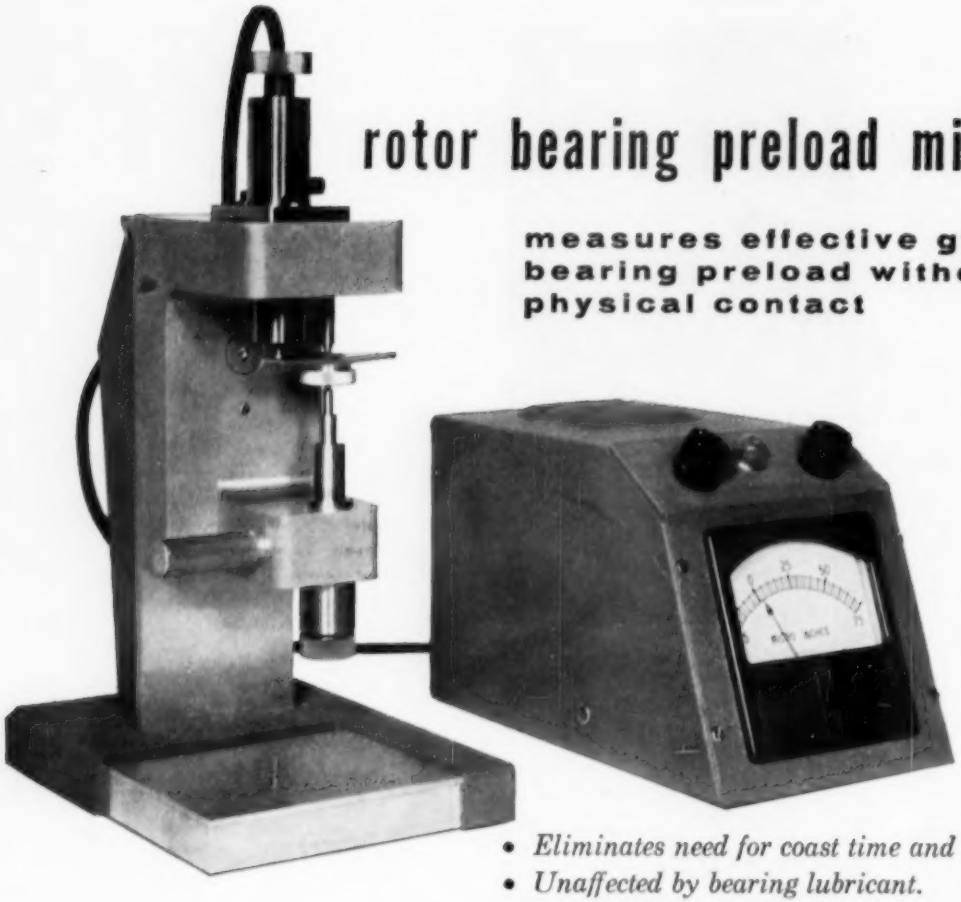


Here's just one example of the many types available!

rotor bearing preload micrometer

measures effective gyro rotor bearing preload without physical contact



- *Eliminates need for coast time and acceleration tests.*
- *Unaffected by bearing lubricant.*
- *Amazingly compact and portable.*
- *Rugged construction for production line service.*
- *Sensitivities as high as .000005 inch per division.*

THE DECKER MODEL 104-1 ROTOR BEARING MICROMETER provides a positive and accurate means of measuring effective bearing preload . . . a prime factor in rotor performance.

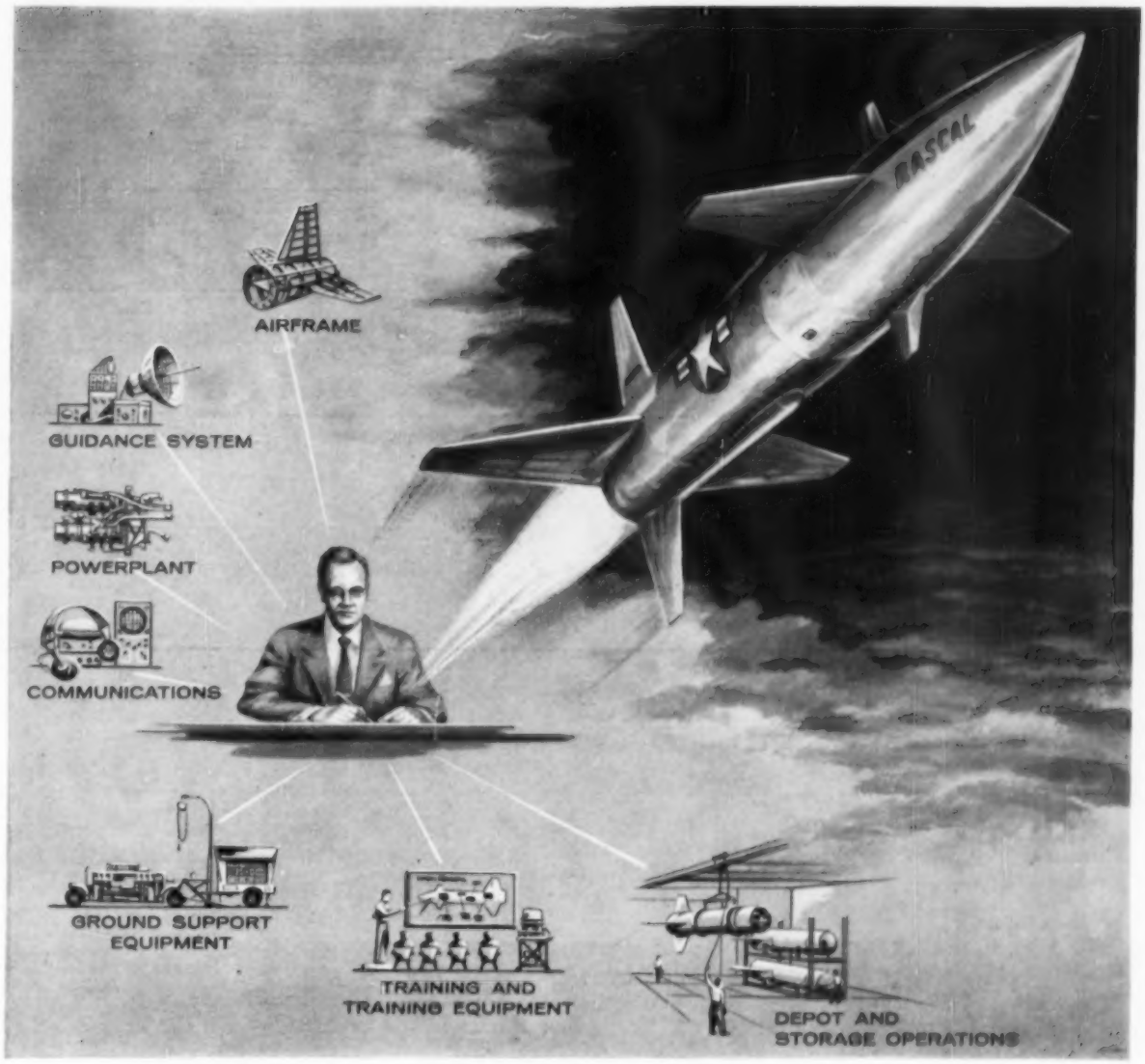
Accurately measuring axial movements to known standards, the micrometer simplifies one of the most difficult jobs in rotor assembly . . . obtaining prescribed bearing preload. Benefits gained include a reduction in rotor assembly time...less need for skilled labor . . . no chance of bearing damage during run-in . . . and fewer rejections due to improper preload.

Simple adapter assemblies quickly convert the unit for handling many types of rotors, ranging in size from less than ½" diameter to 3¼" diameter.

Complete information on this unique new instrument is in Data Sheet 104-1, available upon request to the Technical Literature Section.

DECKER AVIATION CORPORATION

Philadelphia, 25



Weapon Systems Management

.....IS OUR BUSINESS

The air-to-surface GAM-63 "Rascal" of the USAF has already clearly demonstrated the capabilities of Bell Aircraft Corporation's ***Guided Missiles Division*** for the complete and highly efficient management of any weapon systems program.

This large and diversified team of specialists has the skills and experience necessary to follow a system through from the idea stage until it is operational. Each step—each phase is closely coordinated with time an ever essential consideration. Airframe, power plant and avionics are interrelated. Test and training devices, personnel training, ground support equipment and auxiliary systems follow in their proper sequence. The system comes into being under unified, centralized management—with dispatch and efficiency not possible in assembling component units which have been produced under a divided responsibility.

Some 100,000 man years of experience in this field have been logged by the men in the ***Guided Missiles Division***. Their past is history worthy—their future important in our national defense.

BELL Aircraft CORP.

Guided Missiles Div.
BUFFALO, N. Y.

THE BIG STICK

Since 1946, Martin engineering has placed special emphasis on the science of rocket and missile development.

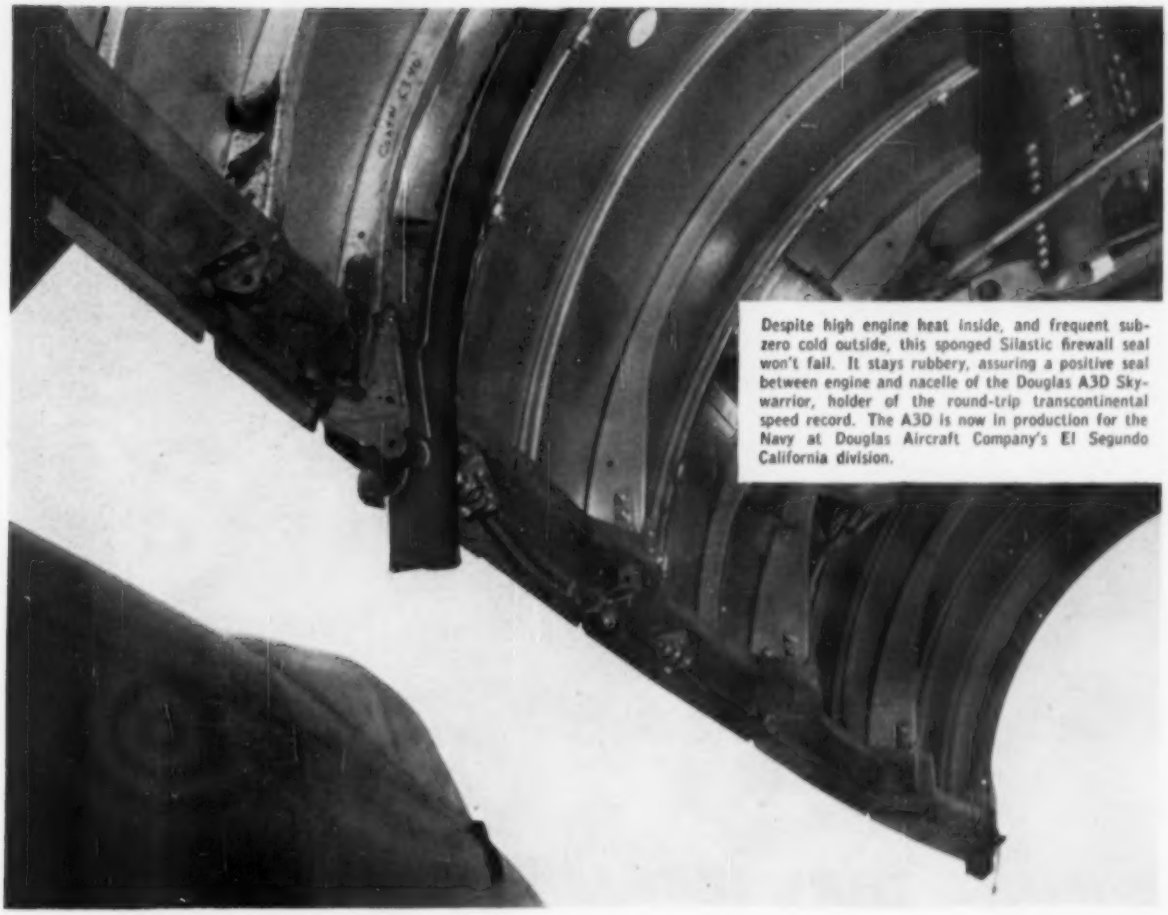
It is because of this that Martin is now building a most potent and important weapon system—the ICBM Titan—an ocean-spanning missile to back up the traditional American policy of peace with honor: *"Speak softly and carry a big stick!"*

From this intercontinental peace protector to the world's first satellite launching vehicle now nearing completion, Martin engineering is pioneering the new age of missiles and rockets.

If you are on the watch for tomorrow, watch Martin today.

MARTIN

BALTIMORE DENVER ORLANDO



Despite high engine heat inside, and frequent sub-zero cold outside, this sponged Silastic firewall seal won't fail. It stays rubbery, assuring a positive seal between engine and nacelle of the Douglas A3D Skywarrior, holder of the round-trip transcontinental speed record. The A3D is now in production for the Navy at Douglas Aircraft Company's El Segundo California division.

SILASTIC sponge withstands severe hot-cold cycles

SILICONE RUBBER

Temperature extremes of —130 or 500 F won't impair the efficiency of Silastic*, the Dow Corning silicone rubber. Sponge made of Silastic stays resilient despite temperature cycling, ozone, or weather. It keeps its shape, keeps its physical properties, keeps its performance. Silastic sponge is produced in almost any size, shape, or color by leading rubber companies.

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Midland, Michigan

Please send me latest data on Silastic

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Typical Properties of Silastic Sponge

- Temperature range, °F — 130 to 500
- Ozone resistance excellent
- Specific gravity 0.25 and higher
- Corrosion Noncorrosive to metal
- Structure Closed cell

Lightweight • Flexible • Weather resistant

*T M REG U S PAT OFF

If you consider ALL the properties of a silicone rubber, you'll specify SILASTIC.

first in silicones

Dow Corning CORPORATION
MIDLAND, MICHIGAN

Progress with **TITANIUM**

J-57 compressor rotor, operating at several hundred degrees F., uses discs, blades and other parts of MST 6Al-4V titanium alloy.

MORE THRUST PER POUND

Teamwork of specialists applies titanium alloy to improve mightiest U.S. jet engines

The bold use of new materials is one of the reasons for the preeminence of Pratt & Whitney Aircraft's J-57, and newer J-75 jet engines.

The MST 6Al-4V titanium alloy, which Mallory-Sharon helped develop and introduced commercially, is used in quantities of hundreds of pounds to increase the thrust-per-pound ratio of these engines. This alloy meets the rugged conditions of stress and temperature in engine use.

Mallory-Sharon, one of the first materials producers for this engine, supplies the MST 6Al-4V alloy to various specialists for fabrication . . . Ladish Co. and Wyman-Gordon Co. for spacer and disc forgings . . . Thompson Products, Inc., Eaton Manufacturing Co., Steel Improvement & Forge Co. for blades and other parts . . . which are all furnished to Pratt & Whitney Aircraft.

Let Mallory-Sharon, technical leader in titanium, help *you* apply this new metal. It has the strength and lightness needed in engines and aircraft, the superior corrosion resistance demanded for chemical processing equipment. Write for information.

MALLORY Ti SHARON

MALLORY-SHARON TITANIUM CORPORATION · NILES, OHIO

Producers of titanium and titanium alloy sheet, strip, plate, rod, bar, billets

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A SPECIAL BREED OF CAT...

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Convair F-102-A

2 DIVISIONS TO SERVE YOU

At left:
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Aircraft Parts
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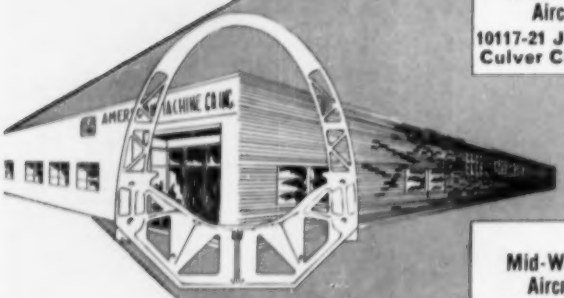
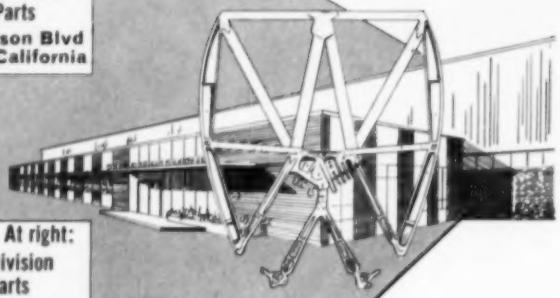
Culver City, California





At right:
Mid-West Division
Aircraft Parts
1450 E. 19th Street
Indianapolis, Indiana

Illustrated above are typical structural machined aircraft parts and assemblies currently being manufactured in the two divisions. The aircraft divisions operate under Air Force approved Quality Control systems. Each division possesses the most up-to-date equipment for its specialty including many pieces of equipment designed around a particular part. . . . . .

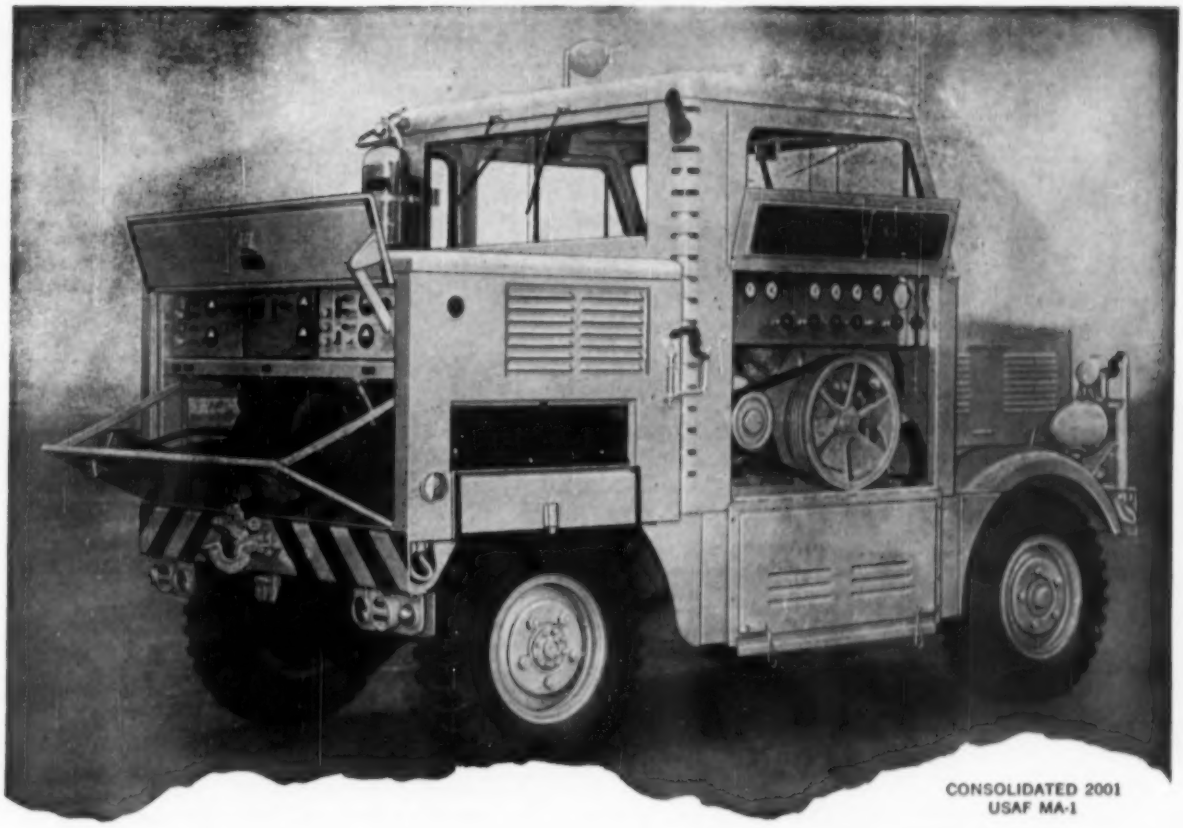
Convair B-58

Boeing B-52

H&B AMERICAN MACHINE CO., INC.

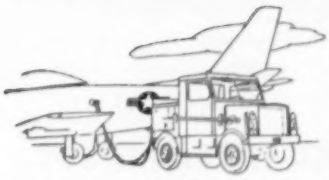
General Offices: Prudential Plaza, Chicago 1, Illinois

THIS IS



CONSOLIDATED 2001
USAF MA-1

GROUND SUPPORT !



To meet the vital jet age needs of ground support, Consolidated has devoted its fullest resources developing both single and multi-purpose units . . proven efficient . and now in active service. Typical of these units is the Consolidated Model 2001 (U.S.A.F. MA-1). This highly compact self-propelled vehicle combines in a single unit all requirements for towing, testing, servicing and starting jet aircraft.

It provides

- **A.C. POWER . . . 30 KVA, 400 cycles, 3 phase and 10 KW 1 phase, close regulated.**
- **D.C. POWER . . . 28.5 volts, up to 2250 AMP. For Split or single bus start and servicing.**
- **COMPRESSOR . . . Air supply up to 3500 psi, 13.5 CFM, 1,000 cu. in. reservoir.**
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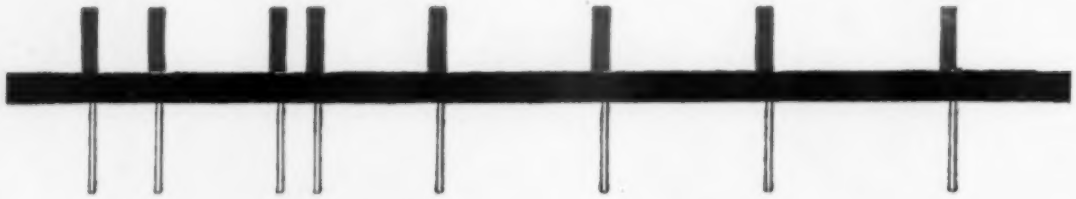

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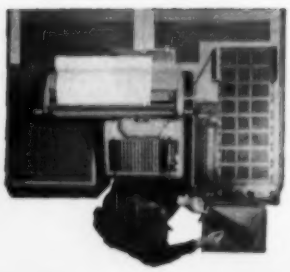

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Vol. 66, No. 26

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COVER: High altitude suit to protect pilot against explosive decompression at altitudes above 80,000 ft. is under development by B. F. Goodrich aviation products for Navy. Cmdr. Jack Morrissey, wearing the suit, enters cockpit of a Chance Vought F8U Crusader at the Naval Air Test Center, Patuxent River, Md., where the suit is being tested. Suit retains pressure in case of bailout, protects pilot against exposure and keeps him afloat in water.

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From take-off to touch-down, an American pilot is surrounded by thousands of dollars of equipment that has one major function—to bring him back alive.

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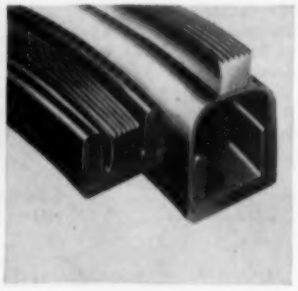
BFG wheels, brakes, tires give maximum efficiency and safety during take-offs and landings.



BFG inflatable canopy seals maintain cockpit pressurization, at any altitude...won't blow out.

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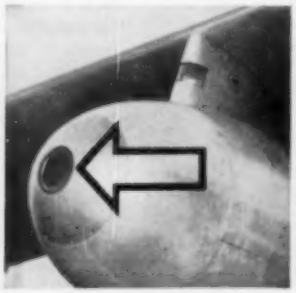
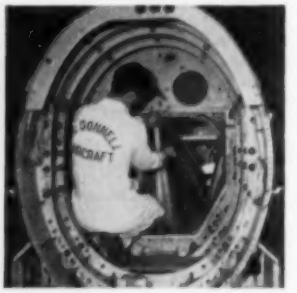


BFG heated rubber prevents plane-crippling ice formations at critical points, such as air intakes.



BFG pressure sealing zipper panels seal asphyxiating jet engine fumes out of cockpit.

EDITORIAL

Where Do We Stand?

Events of the past few weeks in the White House, Pentagon and on Capitol Hill have created an enormous aura of confusion and uncertainty as to the genuine status of our military airpower program. Although considerable confusion still remains, and it is virtually impossible to reconcile the divergent policies being pursued by the White House and the Department of Defense, some of the dust has settled as a result of meetings before the Senate Appropriations Committee and in the Pentagon between USAF and aviation industry leaders.

Some clear trends, most of them reported in AVIATION WEEK for more than a year, have been outlined to industry leaders in blunt and unmistakable terms by top USAF brass. And some of the financial legerdemain by which the military airpower program would have been irreparably damaged has been exposed and expunged from the Pentagon record, thanks to the courageous and candid actions of USAF Secretary James H. Douglas.

Most important is the fact that there is no change in the long range, overall planning for the procurement of airframes, powerplants, avionic equipment, missiles and supporting equipment. This will continue to run at about a $10 billion annual level with a rough breakdown of about $7 billion for USAF; $2.5 billion for Navy and close to $1 billion for the Army.

However, there will be significant changes in the composition of this $10 billion market none of which should come as any surprise to readers of AVIATION WEEK. The trend towards a larger portion of the military hardware sales dollar going for avionic equipment started more than five years ago and is continuing along the rising curve of recent years. Missiles will naturally account for an increasingly larger portion of this market in the future. But even in their advanced forms now contemplated, missiles are not an ultimate absolute weapon nor is there any serious thought in the Pentagon that they will ever completely replace manned vehicles in the military airpower arsenal

For several years, going back to the days when Roger Lewis was assistant secretary of the Air Force for materiel, top USAF leaders have been warning the industry that they were becoming increasingly selective in their buying and were placing heavy emphasis on a firm's past performance in economic production and technically sound development. They also warned that as weapon systems became more complex and expensive the airpower dollar would be concentrated in fewer but larger weapons systems, and the competition for these larger plums would get increasingly stiffer.

In the recent Pentagon meeting (AW June 24, p. 26), USAF leaders have again emphasized this trend and given industry management some clear guidelines by which the Pentagon will judge efficient contractor operations in the future. Incidentally, this is the first such USAF-industry meeting of this type since Defense Secretary Charles E. Wilson and his then Undersecretary Roger Kyes summoned aviation leaders to the Pentagon for a wire brushing in the spring of 1953. We think these meetings are an excellent idea and should be held periodically to promote a closer liaison between the military customers and the industry that is serving them.

Industry management can find little to quarrel with in the USAF request that it reduce overhead, abandon the mass engineering approach that stockpiled engineers like cordwood and return to a more qualitative evaluation of engineering output; streamline production methods to get lower unit costs, and keep technical development active in the fields that will dominate the future.

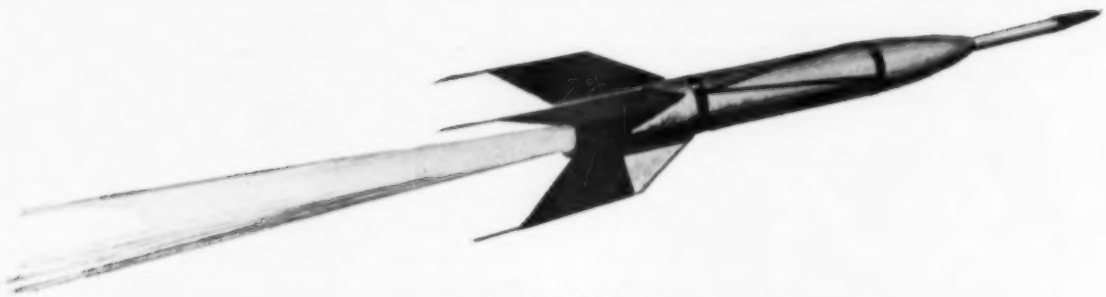
During the frenzy of the Korean war expansion and its aftermath from 1950-55, management of necessity became looser and overhead grew disproportionately. Some companies saw the handwriting on the wall several years ago and have already moved to tighten their management, improve production and put the emphasis on technical quality rather than sheer quantity. Others will have to follow suit in drastically tightening their management or their prospects for survival in the future scramble for weapon system contracts will indeed be dim.

Similarly, the anticipation and harnessing of new technical trends to the fortunes of individual firms continues, as it always has been in this industry, to be an indispensable element of economic survival. Engine manufacturers who have concentrated on the turbojet to the exclusion of rockets, ramjets, chemically-fueled and nuclear engines will find future going tough. Airframe manufacturers who have developed no missile or avionic capacity or whose technical scope and depth is not sufficient to handle prime weapon systems will have to shift their pitch to subsystems or component work or find their fortunes fading. Companies who find their military market falling will have to tax their ingenuity to get a larger share of the rapidly expanding commercial markets for executive transports, civil helicopters and airline transports.

Thus it is clear, as it should have been to anybody who read the technical handwriting on the wall or listened to the speeches of Roger Lewis, Lt. Gen. C. S. "Bill" Irvine, deputy USAF chief of staff for materiel, and Maj. Gen. David Baker, chief of procurement for Air Materiel Command, that the aviation industry and its related technologists are in for a period of shifting fortunes for individual managements in which the rewards for success will be greater and the penalty for failure will be a sharp economic bite.

There are still some serious and, we hope along with Secretary Douglas, only temporary fiscal problems in the funding of the airpower program over the next 12 to 24 months. The ill-advised attempt to abruptly end partial financing of long range equipment programs has been abandoned once its full implications were made clear by Secretary Douglas. However, the problem of holding federal expenditures within the statutory debt limit still has grave implications for the Pentagon. Even the program proposed by President Eisenhower for Fiscal 1958 does not provide for many essentials of a sound airpower program and will reduce the rate of progress toward the airpower strength goals consistently promised the American people by the President and his defense aides. Even Defense Secretary Wilson is now alarmed at the prospect of facing up to airpower cuts at the very time when our international bargaining position is becoming most critical. So are we. —**Robert Hotz**

WHEN YOU WANT IT...



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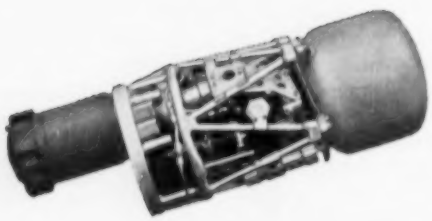

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WHO'S WHERE

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Allan Easton, president, General Transistor International Corp., newly established subsidiary of General Transistor Corp., Jamaica, N. Y. Also: **Walter Bower,** vice president and general manager.

J. W. Keener, president, The B. F. Goodrich Co., Akron, Ohio. Mr. Keener succeeds **William S. Richardson,** retiring.

G. W. Hall, chairman, The Fairey Aviation Co., Ltd., Middlesex, England. Mr. Hall continues as managing director of the British company.

Fred M. Stefan, executive vice president, Marbon Chemical Division, Borg-Warner Corp., Chicago, Ill.

Robert S. Gardner, vice president, Wyle Laboratories, El Segundo, Calif.

James W. Sneller, vice president, Mantec, Inc., El Segundo, Calif.

John E. Slatky, vice president, Sierracin Corp., Burbank, Calif.

Felix Aubuchon, vice president, Pacific Northern Airlines, Inc.

C. E. McCollum, vice president-national accounts (New York), Trans World Airlines, Inc. **J. C. Harrigan** succeeds Mr. McCollum as vice president-central regional sales (Chicago).

Gerald Rosenberg, a vice president, Consolidated Diesel Electric Corp., Stamford, Conn.

John A. Dundas, vice president-general administration, Douglas Aircraft Co., Inc., Santa Monica, Calif.

Maurice Lethbridge, executive assistant to the president, Eastern Air Lines, Inc.

Joseph L. Katz, assistant to the president, General Hermetic Sealing Corp., Valley Stream, N. Y.

Brig. Gen. Francis F. Uhrhane has been appointed Deputy Chief of Staff, Communications and Electronics, Continental Air Defense Command, Colorado Springs, Colo.

Robert L. Jahnke, European sales manager (Frankfurt, Germany), Allison Div., General Motors Corp., Indianapolis, Ind.

Honors and Elections

Col. Bernt Balchen, aviation pioneer, has been named outstanding aviator of the year by the National Pilots Association. Col. Balchen was the first to receive the newly established award.

Lt. Col. Frank K. Everest, Jr., first pilot to fly the Bell X-2, has received the 1957 Octave Chanute Award from The Institute of the Aeronautical Sciences "for his outstanding contributions to the development of rocket-powered flight test techniques."

I. Irving Pinkel, acronautical research scientist of the NACA Lewis Flight Propulsion Laboratory, has received The National Advisory Committee for Aeronautics' highest award, the Distinguished Service Medal, for "his scientific research on causes of fire and impact hazards in aircraft crashes. . . . These scientific contributions enhance the safety of air transportation."

Andrew B. Shea, president of Pan American-Grace Airways, Inc., has been awarded an honorary Doctor of Laws degree from Fordham University.

INDUSTRY OBSERVER

► **Reaction Motors powerplant for North American Aviation's high-altitude X-15 research vehicle will have a thrust of approximately 60,000 lb., a burning time of between one and three minutes.**

► Convair missile engineers in charge of the Atlas project estimate that about 95% of the engineering data anticipated from the first test firing of the intercontinental ballistic missile at Cape Canaveral, Fla., (AW June 17, p. 27) was obtained before the missile was detonated in the air by the range safety officer because of control problems.

► **Lockheed will complete production of the 44 Model 1649 Starliner transports now on order by the end of the year and, unless further orders develop, the corporation will take a substantial loss on the project.**

► Pentagon insiders are betting that North American Aviation Inc. will get the USAF order for the twin-engine crew readiness trainer requirement with its Sabreliner (AW June 24, p. 31) featuring a top speed of 540 mph. and a cruise speed of Mach .76 at 39,000 ft. Sabreliner will be powered by General Electric J85 turbojets located in wing roots.

► **Sylvania Electric will announce development this week of a new type flat tube display with possible applications in radar, television and computers.**

► Navy is becoming increasingly strict in its requirements for manufacturers to meet performance and weight estimates of new aircraft. Profits were cut on North American's T2J jet basic trainer because the aircraft's stall speed was found to be six knots higher than predicted and it was 10 lb. overweight.

► **First Republic F-103 high speed interceptor powered by a turbo-ramjet engine is scheduled to roll out in February if it isn't caught first by USAF's economy pinch.**

► Hiller Helicopters has developed a propulsion unit for the Army composed of a set of up to eight valveless pulsejets mounted in vertical plane for attachment to prefabricated bridge sections. Unit would lift bridge section from the ground, fly it at speeds of up to 30 mph., then lower it into place at its new location. Powerplants are French Snecma developments. Number of pulsejets can be varied in the propulsion unit according to requirements.

► **Republic Aviation is conducting a USAF design study to develop an airborne hydraulic system that can operate in an environment of 1,000F.**

► Army has just completed field tests of a modified Beech L-23 fitted with two 240 hp. engines in place of the standard 340 hp. Lycoming engines. Modified version also has suction type boundary layer control system and other drag reducing features designed by Dr. August Raspet of Mississippi State College. In a typical comparison run, the Raspet version flew at 169 kt. at 61% power with 80 octane fuel, while the standard Army aircraft flew at 166 kt. at 63% power with 100 octane fuel. Total research cost of the modified version was $21,000.

► **Bell Helicopter Corp. has raised the gross weight of its Model 47J helicopter from 2,565 lb. to 2,800 lb. by installing hydraulic irreversible valves in the cyclic control system. CAA approval of the new gross weight includes certification for operation of the helicopter's Lycoming VO-435 engine at 240 hp., a 20 hp. gain. Modification kit will be available for present 47J operators.**

► Recent research in meteor burst communications (AW June 17, p. 96) using high power radar has revealed the existence of meteors too small to be seen previously and bolsters apparent correlation between precipitation and the presence of small meteor showers. One theory on the basic mechanism that triggers rain and snow storms is that the tiny meteor particles provide the nuclei for releasing precipitation.

► **North Atlantic Treaty Organization plans a new military airfield at Kalkanli, Turkey. Estimated cost: $3.9 million.**

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smaller, lighter • • •

aid miniaturization of electronic devices

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Where standard designs are not suitable, Airborne can produce special capacitors to meet your requirements. These custom miniatures likewise offer the advantage of reduced size and weight without sacrificing capacitance or dielectric strength. Typical is one of our new starting capacitors which is 75% lighter yet has twice the capacity and three times the dielectric strength of the old-style capacitor it replaced.

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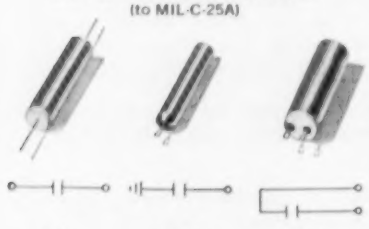
(to MIL-C-25A)



Style "A" | Style "B" | Style "C"

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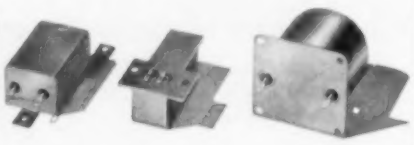
(to JAN-C-25, MIL-1-6181B, MIL-M-8609)



E-8109 Style | E-8104 Style | E-8107 Style

Airborne Standard Miniaturized Capacitors—200 v d-c

Microf. ±10%	Dia.	Length
.25	3/8	1-1/4
.5	1/2	1-1/4
1.0	5/8	1-1/4
3.0	7/8	1-1/8
4.0	1	1-1/8
5.0	1-5/32	1-1/8
6.0	1-1/4	1-1/8
7.0	1-5/16	1-1/8
8.0	1-29/64	1-1/8
9.0	1-1/2	1-1/8
.25	3/8	3/4
.4	1/2	3/4
.75	5/8	3/4
1.5	1	3/4
18.0	1-3/4	2-1/4

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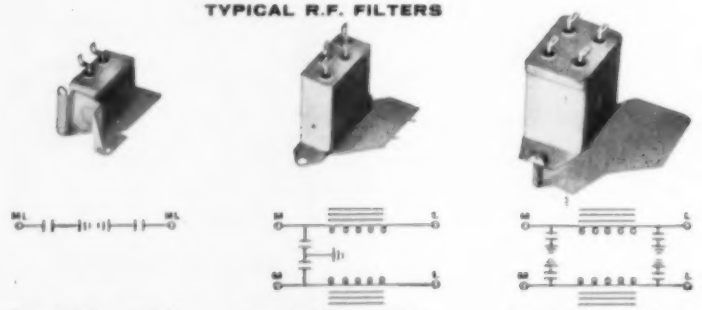
TYPICAL R.F. FILTERS



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Washington Roundup

New Overtime Directive

Recent service directives cutting overtime pay in aircraft contracts (AW May 6, p. 29) have been clarified and amplified in a new Department of Defense Instruction (4105.48) which is also intended to give uniformity to defense contracts. Defense felt Army had gone too far in slashing overtime, that Air Force hadn't gone quite far enough. New instruction is closer to Navy's version.

Services still have ample room to exempt projects from overtime restrictions, and this will be done to a large degree with most ballistic missile contracts. New order actually relaxes the restrictions somewhat, leaving more allowance for emergencies, etc. But the purpose is clearly stated: "To effect an immediate, continuing and sharp curtailment in the use of overtime in the performance of all kinds and types of Department of Defense procurement contracts. . . ."

Power to authorize overtime up to 2% of a project's total man hours remains with plant representatives. Anything over that must be approved by procurement agencies. Disputes, where action by one service might jeopardize contract of another service in the same plant, can be bucked all the way to Assistant Secretary of Defense for Supply and Logistics for final decision.

Defense admits instruction is aimed partly at cutting current spending rate but also says laxness had been increasing in authorization of overtime and it is good business to cut it back.

Word "continuing" means hold-down on overtime will last at least through Fiscal 1958, but Defense spokesman said exceptions will be granted whenever the total cost of operating on straight time appears to be costing more than paying overtime.

Instruction specifically states that use of overtime pay as part of an employe's salary is "contrary to the principles of this instruction."

House-Senate conferees last week approved a $106 million Fiscal 1958 budget for the National Advisory Committee for Aeronautics. The figure is almost $30 million more than the Fiscal 1957 budget. However, NACA had requested $118 million.

The House allowed $105 million, but House conferees last week accepted the $106 million voted by the Senate and also went along with a Senate provision continuing NACA's authority to contract with universities and other private institutions for research and development work. But it did place a limitation of $500,000 on this type of contracting. Earlier, the House had banned outside contracts by NACA.

Acceptance of the $106 million by House and Senate is expected to be routine. The total is divided.

- **Operations, $71 million** as compared with $62.6 million for Fiscal 1957.
- **Construction and equipment, $35 million** as compared with $14 million for Fiscal 1957.

Air Defense Problem

Watch for Brig. Gen. Howell M. Estes to move into the Pentagon as assistant chief of staff of the Air Force for air defense. Post would be similar to the special job created for a missiles' coordinator several years ago for similar reasons relating to improving the air defense picture. Estes is now head of the Weapons System Management Office of Air Research and Development Command at Wright Air Development Center. During a recent presentation to the Institute of the Aeronautical Sciences in Los Angeles, Gen. Estes noted that the air defense problem might require the services of an overall civilian system manager similar to the Ramo-Woolridge Corp. relation to the USAF ballistic missiles program.

New Investigation

House Armed Services Investigating Subcommittee headed by Rep. Edward Hebert (D.-La.) plans a "major" investigation of aircraft and other defense subcontractors. "Particularly, we want to find out how much profit prime contractors are making on subcontracts," Hebert says. Public hearings won't get under way before next year. Meanwhile, the subcommittee plans to open hearings in its investigation of the procurement practices and profits of 17 aircraft engine manufacturers on July 8 (AW Apr. 1, p. 27).

Small Business

Watch for a change in the definition of "small business." This means that some firms which now enjoy the advantages of procurement regulations aimed toward assisting "small business" will be removed from the category and others will be added. Congress is strongly opposed to the arbitrary criterion of "500 or less employes" which has been used until now. The House and Senate Small Business Committees want other factors such as net worth, dollar volume, position in its field, etc., considered.

Farewell to OSI

Office of Strategic Information died with the end of Fiscal 1957 as the parent Commerce Department decided not to ask the Senate to restore funds needed for its survival which had been cut out by the House. House Government Information Subcommittee urged abolition of OSI after hearings last year. Chairman John E. Moss (D.-Calif.) said OSI had been unable to justify its existence either for "restricting unclassified information from within the government or controlling unclassified information from outside the government" and said the office "seemed to operate in an aura of complete confusion . . . (with) a highly unrealistic attitude of cloak-and-dagger self-importance."

New Arms for Korea

USAF units in Korea are finally being equipped with aircraft to more equally match the MiG-17 fighters that have been moving into North Korea since the signing of the armistice almost four years ago.

Officially both the Pentagon and Air Force officers on the scene have declined to say just what type aircraft will replace the North American F-86s, a hangover from the Korean War. Best bet, however, are North American F-100s recently sent to Japan.

Modernization plan was preceded by United Nations Command announcement that it was nullifying the arms proviso in the armistice designed to prohibit the introduction of new weapons into Korea. Communists, who also agreed to the proviso, began moving new arms and aircraft into North Korea from China within days after the final agreement was signed in the summer of 1953.

—Washington staff

USAF Gives Industry Guides to Survival

Top Air Force officials tell industry how to live under administration-imposed spending ceilings.

By Evert Clark

Washington—Industry has been given guidelines for survival as Air Force prepares to stay within administration-imposed spending ceilings in spite of rapidly rising costs and the expensive transition to more missiles and fewer aircraft.

Details of a recent Pentagon briefing for top industry executives (AW June 24, p. 26) reveal that USAF has told management to:

• **Cut overhead.** Figure suggested is 12%, the amount by which USAF is cutting its headquarters overhead in Fiscal 1958. Included are personnel, leased space, facilities, etc. Aircraft prime contractors were told they face the alternatives of reducing plant production facilities or eliminating all charges to the government.

• **Cut engineering costs.** This already has resulted in orders aimed at severely curtailing overtime (see p. 29). Another target is duplication of various engineering capabilities at branch and division plants. Companies were warned against "using the method of quantity engineering instead of quality engineering."

• **Cut unit price** even though production volume is reduced. Pattern has been that unit cost is highest when volume is lowest. Industry was told, however, that fewer weapon systems and fewer aircraft of a type will be procured in the next few years, and that unit cost must stay down in spite of lower orders.

Assistant Secretary for Materiel Dudley C. Sharp called for economies all the way from "executive compensation" to labor costs.

Lt. Gen. C. S. Irvine, Deputy Chief of Staff for Materiel, said solution of these "very real problems" will require "changes in thinking not only here in the Pentagon but in the management of every plant in the country, and right down to the folks doing the work."

Burden obviously is being placed largely on individual managements. Even though broad guidelines have been laid down, further briefings will be held, and directives and procurement regulations will be issued both by Defense Department and Air Force.

Briefing Highlights

Other highlights of the briefing:

• **Partial funding,** although it has helped create the current situation in which spending is running ahead of estimates, has been virtually eliminated as a part of the current problem. Compromises between Defense Secretary Charles E. Wilson and his comptroller, Wilfred McNeil, on one hand and Air Force on the other will result in less and less partial funding as time goes on, but cutdown will be gradual enough not to jeopardize USAF's program.

• **Wing strength.** Secretary James H. Douglas admitted that USAF "really dropped this year five wings out of what we have always referred to as the 137-wing program," as pointed out by Aviation Week last Jan. 21 (p. 26). "We have changed the composition of that program a little bit so that we actually have 137 wings, but there is the reduction of five that I refer to," Douglas said. Nine more wings have been cut from the Fiscal 1958 budget, Douglas said, "so that really in a period of about a year and a half we will have programmed out roughly 10% of our wing strength."

• **Stretchouts and cancellations** of contracts. Sharp made it clear that this is largely undecided so far. To cut expenditures will require "some kind of drastic action," Sharp said. "It may take the form . . . of the elimination of some programs. We hope not; we do not know, it may take the form of stretching out some of our programs. . . . All of us are going to have to indulge in considerable soul-searching."

• **Firms which have** not moved into missile and electronic fields will be hardest hit (see box below). Turbojet engine manufacturers face sharp curtailments—40% of current procurement—over the next few years, with airframes next in line.

"The regime of the turbojet engine, development and production-wise, appears to be reducing in the not too distant future," Maj. Gen. David H. Baker, director of procurement and production for Air Materiel Command said. ". . . Production facility data for this industry . . . is as severe, or even worse, than that . . . for the aircraft industry itself. The projected production quantities will not support the present complex of jet producers. Therefore, a shrinkage in engine plant capacity for the jet producers is indicated in the years ahead."

Limited Money Channels

• **"Significant changes" in company** responsibilities. "Buying fewer numbers of aircraft systems and lesser overall quantities will almost inevitably result in fewer prime weapon systems contractors," Gen. Baker said. "Money will be flowing to the industry through a much more limited number of channels. Neither the R&D nor the procurement budget can continue to support the losers of new systems contracts on the scale that now exists."

Weapon systems concept will have more and more impact, he said, especially in electronics.

Consequences, Baker said, include continuation of USAF's policy that aircraft firms—facing "the impact of reduced aircraft"—will be "designated as missile-system contractors even though some electronic companies have, with good justification, argued that they should be prime in complex missile systems. The primes will continue to play an increasingly important role in the managing of weapon systems. . . .

"If we are to restrict the prime wea-

Where USAF Dollars Will Go

Washington—Breakdown of planned Air Force procurement over the next several years, reflecting the rapid shift in emphasis from manned aircraft to missiles, was given to industry leaders at a USAF briefing by Maj. Gen. David H. Baker, director of procurement and production for Air Materiel Command.

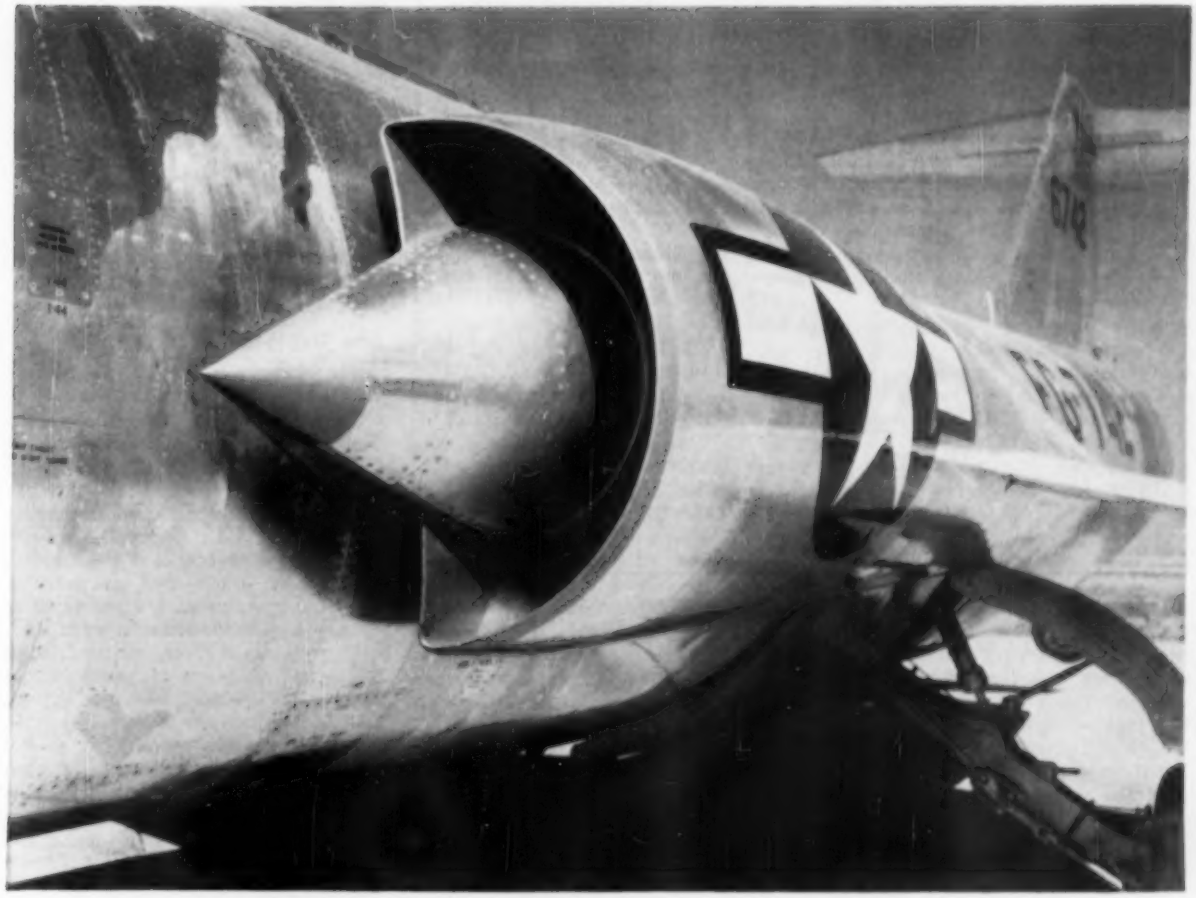
Figures are based on an expected constant dollar availability of $7 billion and do not consider any obligation or expenditure ceilings which might be imposed in the future, Baker said. They also exclude research and development and operations and maintenance procurement items. Basis of comparison is Fiscal 1956.

• Aircraft—Drop from $4 billion to "something slightly less than $2 billion."

• Missiles—Increase from $500 million to around $2.8 billion—a jump of $2.3 billion, which more than offsets the loss in aircraft. Baker explained that some electronics spending is included in this missile figure but most is reflected in the electronics item itself.

• Engines—Drop from $1.5 billion to less than one billion, or a reduction of one-third. Turbojet engines will drop 40%, but ramjet and rocket engine increases will partly offset this, Baker said.

• Electronics—Jump from $750 million to $1.3 billion, almost doubling and reflecting "the increased role of electronics in the complex weapons we are building."



F-104 Inlet Uses Two Boundary Layer Bleeds

First close-up of the Lockheed F-104 inlet shows two boundary layer bleeds. First bleed is large gap between the inlet and the side of the aircraft which allows the fuselage boundary layer to pass the duct without spilling in. Second bleed is visible inside the duct just behind the spike. This bleed presumably prevents separation as air rushes up the spike and then turns to enter the engine. Barely discernible etching on the fuselage beginning at spike nose has the same shape as shock wave created by the spike.

pon system contractor to his role of phasing and integrating subsystems, we need more companies who have a complete subsystem capability, both design-wise and production-wise (AW June 24, p. 39).

". . . There is a clear requirement for those companies so qualified to expand their horizons and more aggressively acquaint themselves with the unresolved subsystems requirements which confront both the weapons contractor and ourselves."

Dollar Availability

• **Dollar availability.** Planning is going ahead on the theory that the current levels of approximately $7 billion for procurement and production, $700 million for research and development and $10 billion for operation of USAF will be available over the next few years. Pinch comes, however, in the fact that current spending is running above those levels, and the administration insists that it be cut.

Although spending estimates for Fiscal 1957 and 1958 were far off from what actual spending has turned out to be, Douglas said procedures used to make the estimates "were almost uniformly accurate" in Fiscal 1954, 1955 and 1956.

But "rapid, spectacular growth of the ballistics missile program during Fiscal 1957" shortened lead time, obligating early in the year and compressing programs, rising costs, and other factors put spending out of line.

"The payment on (the ballistic missiles) program during the year (Fiscal '57), or during the first six months of the fiscal year, substantially doubled as against the estimate for that program when the budget for 1957 was formulated by the Air Force," Douglas said.

"Also the manner in which that program has been financed has contributed to the situation in that we have not been financing the purchase of end items two years in the future. We have really been paying for effort as we went along, and making available funds to meet the requirements for the next four or six months.

"Although it was realized that this program would spend more rapidly than a normal program, it was never estimated that it would spend at the rate of something like 60% to 70% in the first year of the program."

Hold Unit Cost Down

• **Unit price.** Sharp said "we ought to look carefully" at the "customary thinking in Air Force and the industry that a reduction in the rate of production is accompanied by a rather drastic increase in the unit price. . . . We must find ways to reduce the overhead and the other expenses to keep the cost of the products very closely if not exactly the same as they were when they were produced in higher quantity. This will take all of the ingenuity, I am sure, which you can develop."

• **Engineering.** "It is timely now to take a good look at all of our engineer-

USAF Representatives

Washington—Air Force officials attending the Pentagon presentation on reduction in costs of development and procurement programs included:

- **Secretary James H. Douglas.**
- **Under Secretary Malcolm A. MacIntyre.**
- **Assistant Secretary for Materiel Dudley C. Sharp.**
- **Vice Chief of Staff Gen. Thomas D. White, incoming Chief of Staff.**
- **Gen. E. W. Rawlings, Commander of Air Materiel Command.**
- **Lt. Gen. C. S. Irvine, Deputy Chief of Staff for Materiel.**
- **Maj. Gen. M. E. Bradley, Jr., Assistant Deputy Chief of Staff, Materiel.**
- **Maj. Gen. D. H. Baker, Director of Procurement and Production, Air Materiel Command.**
- **Maj. Gen. R. P. Swofford, Director of Research and Development for Deputy Chief of Staff, Development.**
- **Maj. Gen. J. M. Sessums, Jr., Vice Commander, Air Research and Development Command.**
- **Maj. Gen. D. F. Callahan, Assistant for Programming for Deputy Chief of Staff, Operations.**
- **Brig. Gen. Waymond A. Davis, Director of Procurement and Production for Deputy Chief of Staff, Materiel.**
- **Maj. Gen. T. P. Gerrity, outgoing Assistant for Production Programming, Deputy Chief of Staff, Materiel.**

ing departments and be sure that we are not using the method of quantity engineering instead of quality engineering," Sharp said. Gen. Baker cited the "tendency since the Korean expansion to develop engineering capabilities at branch and division plants." He called this "one of the most costly forms of overhead" and called for "critical re-examination of need and dispersion, as well as our capability to support it."

Surplus Space

• **Facilities.** There is "a tremendous surplus of space in our prime plants," Baker said. "The surplus currently stands at 22.5 million sq. ft. It steadily increases to 57 million sq. ft. by the end of 1961." By then there is a projected 72.5 million sq. ft. available against a need of 15 million. But allowing for "flexibility . . . to accommodate the new program as it phases in to meet scheduled acceleration and to provide for some degree of expansibility" and planning for single-shift operation, the total need is raised to 20 to 25 million sq. ft. Provision has to be made for additional capacity required for "isolated locations, for test and tear-down purposes, and for a certain amount of modernization."

But USAF thinking has been changed by "the advent of the nuclear bomb and long-range bombardment aircraft," which mean "the likelihood of a decisive phase of a war being fought within the first few months has increased tremendously," Baker said.

Result: "We feel today that our limited funds should be placed in a force in being, rather than being utilized to maintain excessive capacity at very heavy cost," Gen. Baker said.

Gen. Irvine said USAF and industry cannot "use people to keep plants open and to guard old World War II empty buildings."

USAF "cannot afford to approve the addition of a single foot of production capacity until we have exhausted every possible alternative and every possible availability in this area," Gen. Baker said.

"A corollary is a similar firm objective attitude on Certificates of Necessity for new construction. Here, we frequently encounter unnecessary facility expansion by industry after industry has completed the construction, and the government absorbs the accelerated depreciation at this time."

• **Lease space.** "We must set in motion immediate plans for the relinquishment of lease space," Baker said. "With very, very few exceptions, our scattered and broken-up parcels of lease space can be accommodated in the space to be freed by declining programs. We intend to police this area very closely."

Baker also said production schedules must be analyzed "and where complete plants are to become idle, prepare to close them."

• **Overhead.** This "demands our immediate attention," Baker said. Normally, relative overhead ration should decline as direct labor outlays increase. "However, despite the large growth in the labor base for the calculation, there has been no corresponding decline in overhead rate—but rather, a steeper climb," Baker said. "This trend in overhead will be given much closer scrutiny and additional emphasis in the contract negotiation phases of our placement of procurement."

Efforts to "stabilize overhead at a constant relationship to the labor base throughout the phase down period" will mean to contractors that "insofar as overhead charges to government contracts are concerned, fixed costs—or supposedly fixed costs—must become variable."

Low Overhead or Profit Loss

"If management is unable to find ways and means of varying these costs to the government," Gen. Baker said bluntly, "then they will have to be paid out of profits."

• **Dual sources.** "New thinking on the matter of a future war" also has had its impact here, Gen. Baker said. "The cost in current funds of maintaining dual sources where they are provided only for protection of a mobilization base cannot be supported at this time."

". . . A rule of thumb that we utilize in examining a second source for an aircraft or engine normally can be estimated at least $100 million before we start any product coming out of the door. These increased costs of dual sources are evident throughout the cost reimbursement areas of our contracting. This applies to all levels of our industrial structure."

• **Subcontracting.** Sharp said congressional committees have called to USAF's attention "several instances where prime contractors have, I might say, not been as careful as they could be in getting the lowest possible prices from the subcontractors." Admitting that this "is a difficult field," Sharp said industry must "somehow or other work out better procurement methods to be sure that you are achieving the lowest possible prices for the material that you are receiving."

Baker said there are "both pluses and minuses" for small business. Increasing use of the weapon system contractor "transfers a large share of the purchasing responsibility away from the government," he said, but "as a minimum we must maintain the present volume of business they are receiving from our programs." Weapon system contractors "must be constantly alert" to make maximum use of small businesses, and USAF "intends to, and must, police this activity," Gen Baker said.

• **Executive compensation.** Sharp called this "a rather touchy subject which I think is a very sensitive one in the present climate of economy both in the Congress and among our people in this country as a whole." USAF "will have to look very carefully at any increases in executive compensation which

Navy Cuts Contracts

Washington—Caught in a budget squeeze, Navy last week terminated its contract for the Douglas A4D-3 advanced carrier attack plane and sharply curtailed its development contract for the Lockheed W2V-1 early-warning aircraft. A4D-3 contract involved a total of four aircraft.

would be charge to government contracts," Sharp said.

• **Reliability.** More than any other factor, reliability is limiting operational capability now and "is becoming more critical as time goes on," Gen. Baker said. In many cases companies "have failed to advance with the weapon system technology, and are following the quality patterns used when their products were much less critical to the performance of the aircraft."

Gen. Baker called for "a general upgrading of the efforts toward uniform quality, a stronger knowledge of the environmental and use conditions surrounding their products and a great increase in the scope and effectiveness of their testing."

• **Development.** Secretary Douglas said all of industry is "familiar with the fact that we have perhaps given some evidence of the changing attitude in development of what we have regarded as very important projects."

"Some we have had to terminate," Douglas said, "and we are faced with the problem of rigid selection on a basis of essentiality of our development projects, and even of some projects that have passed development stage, possibly."

Gen. Baker said "costs of the initial development are at tremendously high levels" in superior missiles and aircraft because of increased ranges and skills demanded and warned that "these development costs are reaching the point that they may be controlling in the decision to undertake new systems."

In aircraft, high investment in planes to be superseded and high development cost of replacement systems "make it essential that we limit our new systems to those that will give us large jumps in performance," Baker said.

"With first articles coming at multi-millions of dollars per copy, this leaves no room for second-guessing or for non-performance aircraft."

Boeing Proposes Plan To Cut B-52G Costs

Washington—Proposal by Boeing Airplane Co. for substantial savings on B-52G procurement costs has been approved in principle by USAF.

Boeing had investigated the idea prior to the recent Air Force briefing to industry on the need for cost-cutting (see page 26). Plan was presented to the Air Force the day after the briefing.

It calls for assembly and delivery of the improved long-range B-52 at the Wichita, Kan., plant only instead of at Wichita and Seattle as previously planned.

This would:

• **Eliminate cost of tooling** the Seattle plant.

• **Terminate Seattle** assembly of B-52s almost a year earlier than previously planned, while still delivering the same total quantity of B-52s in "substantially the same period of time."

• **Concentrate production of Bomarc** interceptor missiles at Seattle. Previous plan had been to build in Wichita and assemble in Seattle.

• **Free part of the Seattle plant** for fabrication and assembly of components for the B-52G to support Wichita production schedules.

• **Free part of Seattle** for work Boeing hopes to obtain in "new advanced aircraft and missile programs." The company says it is "actively seeking such work" and has provided at its own expense a $25 million developmental center.

The B-52G has substantially increased range due to a large wing containing integral fuel tanks (AW May 13, p. 23). After studies with the Pratt & Whitney J75 engine, Boeing decided to keep the J57 in the improved version, emphasizing economy of fuel consumption instead of power, since the larger engine would still not make the bomber supersonic in level flight.

USAF Chooses HOK-1 For Fire-Rescue Use

USAF competition for a local crash-rescue helicopter was won by Kaman Aircraft HOK-1, which carries fire fighting equipment slung on its external cargo hook and a rescue crew of three in addition to pilot.

Procurement of the helicopter will be started in the Fiscal 1958 program.

The competition began in June 1956 and seven companies were entered.

New Helicopter Carrier Planned for French Navy

First picture of French Navy's carrier specially designed for helicopter use, which is now under construction in Brest, France. Schedule calls for the 10,000-ton vessel to be completed by 1961. Carrier, planned for convoy or amphibious operations, will carry 12 French built and developed turbine-powered helicopters, bigger than any now in use, according to the French. Helicopters will be heavy with anti-submarine equipment. Vessel will be 576 ft. long, with a beam of 77 ft. At speed of 15 kt., radius of action is expected to be 6,000 mi. Maximum speed is predicted at 26.5 kt. Armament consists of six automatic 100 mm. guns. Carrier's engines will generate 40,000 hp. Its crew complement will number 1,050. In peacetime it will be used as a cadet training ship.

Quesada Will Contract Airways R&D

By L. L. Doty

Washington—Elwood R. Quesada, new special assistant to President Eisenhower for aviation, told AVIATION WEEK last week that research and development for the future airways system will be conducted by industry or technical universities on a contract basis.

Quesada said contracts may be let by mid-1958 for the development of air traffic control techniques and facilities to insure continuing modernization of the airways system on a long-range basis. He also said he planned to draw heavily on the air transport industry for talent "to participate actively in defining the airways problem and preparing an overall plan."

Quesada, who was sworn in last week at the White House, replaces Edward P. Curtis. Curtis plans to return to his former post as Eastman Kodak Co. vice president in Rochester, N. Y. (AW June 17, p. 25). Curtis headed the Aviation Facilities Planning Group which developed the basic plan for a future airways system.

Quesada told AVIATION WEEK he anticipates making no major changes in the proposals prepared by the Aviation Facilities Planning Group, although Curtis has urged against adhering strictly to the report in making future plans. Quesada referred to the report as a "bible" and said it would serve as a broad-scale guide in developing a detailed program.

Three-Phase Program

Here is the three phase program Quesada intends to follow in implementing the Curtis plan:

• **Improve the** Civil Aeronautics Administration's three year plan for federal airways by accelerating the program and developing doctrines for the use of the equipment installed as a part of the program. Quesada wants to break present bottlenecks in air traffic control at once through "operations research" and the immediate application of improved operational procedures.

• **Define the airways problem** in detail and select from the present state of art those facilities that can be put to work in the system. The program will include tests and experimental activities as a means of integrating techniques, equipment and procedures into the working system. Quesada estimates this phase of the program, which will be handled by the interim Airways Modernization Board (AW April 29, p. 38), will require five years before it is completed.

• **Development of an airways system** for the distant future. This will be a pure research and development program employing techniques and devices that are now unknown or theoretical for an airways system 20 years from now. Quesada said he wants this phase to move "uninhibited by what we now know." He said he does not "intend to touch this step of the progarm for at least one year."

Industry Contracts

Quesada says he will "contract with industry or academic centers for an impartial investigation and research program to uncover vacuums where no work has been done previously." He added that the "entire spectrum of techniques and facilities" will be searched and the most adaptable ideas and equipment will be "extracted from industry at large."

The Airways Modernization staff will consist of experienced representatives from the transport industry and civil aviation as well as from the government and military segments of aviation, Quesada said. He added:

"We will seek personnel who will be influenced by practical requirements and whose vast knowledge will be felt in the concept of an airways system."

He said he would look for technical people who must be "intelligent buyers" and who will serve on a long-term basis so that their loyalty to the AMB will be undivided.

Quesada explained that his role as special assistant is in an administrative capacity without executive authority as contrasted to the chairmanship of the AMB which will have executive authority. His primary task will be to exercise leadership in implementing a permanent plan of organization and in preparing the necessary administrative policy and legislation required to execute the plan.

He will act as an advisor to the President on aviation matters and will serve as non-voting chairman of the Air Coordinating Committee until it is absorbed by the permanent Federal Aviation Agency as an advisory council.

The AMB chairman will serve in a technical capacity, and the presidential assistant will be confined to administrative practices, he explained. Although it is possible that both posts could be held by the same person, Quesada refused to speculate on the possibility of his being named AMB chairman in addition to presidential assistant.

A bill to create the Airways Modernization Board went to the Senate floor last week for debate following its unanimous approval by the Senate Commerce Committee. Most observers are convinced that the bill will pass both sides of Congress this session without any major modifications.

Airspace Problem 'Critical'

The Airways Modernization Board will be established as an interim agency to be superseded after three years by the permanent Federal Aviation Agency.

Asked if he felt this interim period could be compressed into a shorter period of time as suggested by some members of both the House and Senate Commerce Committees, Quesada said he felt the entire three years would be required to lay the groundwork for a permanent plan of organization and to prepare policy and legislation with the required amount of thoroughness.

Regarding the present conflict between civil and military aviation on the allocation of airspace (AW May 27, p. 40), Quesada admitted the problem is now "critical" and promised it would be "examined with a high degree of urgency."

He said such conflicts would continue to be resolved by the Air Co-

Elwood R. Quesada

New special presidential assistant on aviation, Elwood R. Quesada, entered the Air Service Primary Flying School in 1924 after enlisting in the Army. He was commissioned a second lieutenant in the regular Army in 1927 and retired as a lieutenant general in the Air Force in 1951.

Quesada's early aviation experience included flying as an Army air mail pilot on the New York-Cleveland route when air mail contracts with private carriers were cancelled in 1933. He was one of the pilots of the airplane Question Mark which remained aloft in an endurance flight for one week in 1929. Prior to World War II, he was loaned to the Argentine Air Force as a technical advisor.

During World War II, he participated in more than 90 combat missions and served as commanding general of the 12th Fighter Command and deputy commander of the Northwest African Coastal Air Force. In 1946, he served as the first Commander of the Tactical Air Command and between 1949 and 1951, he was commander of the Joint Task Force Three which conducted a series of nuclear tests including the first hydrogen device ever to be detonated.

A native of Washington, Quesada is married to the former Kate Davis Pulitzer. They have two daughters and two sons.

ordinating Committee until the Federal Aviation Agency is established but added that some improvement is in sight since unsettled disputes can now be referred to the President through Quesada as presidential assistant for final decision.

Quesada said military and civil members of the Airways Modernization Board and, later, the Federal Aviation Agency would serve with stronger loyalty to the board and agency than to the segments of aviation they represent since they would not be working on temporary assignment but on a permanent basis. As a result, he said, members would approach such conflicts as now exist between the various aviation groups more objectively.

No price tag has been set on overall costs for the entire program, although it has been estimated that expenditures will be "substantially" in excess of the amounts presently spent for air traffic control. However, Quesada does not advocate the early introduction of user charges nor does he envision direct assessments of airways users soon.

Quesada came to the post of presidential assistant after retiring from private industry where he served as a director and officer of Olin Industries and Lockheed Aircraft Corp.

Negotiated Contract Cutback Is Urged

Washington—House Armed Services Committee is renewing its drive to narrow the area for negotiation of defense contracts.

The Investigating Subcommittee headed by Rep. Edward Hebert (D.-La.) last week called for elimination of one of the 17 possible exemptions to competitive bid contracting under the Armed Services Procurement Act. This exemption authorizes negotiation during the period of an emergency declared by the President. Similar legislation was passed last session by the House but died in the Senate.

The Hebert group pointed out that $5.3 billion of the total $13.6 billion in defense contracts negotiated during the first nine months of last year were justified on the grounds of the emergency declared by President Truman at the outset of the Korean war. The "emergency" has never been revoked.

The legislation, however, is not expected to have a substantial effect in further shifting defense contracts from a negotiated basis to a competitive bid basis since there would remain 16 other possible exemptions. These include: "public exigency;" "impractical to secure competition by formal advertising;" "standardized and interchangeable parts;" "experimental, developmental, or research work."

ATA Says Planned Navy Base Will Cripple California Airways

By Russell Hawkes

Los Angeles—Civil air space users are virtually powerless to prevent cutting of important airways between Southern California and the Pacific Northwest by aircraft from the planned Navy jet base in Lemoore, Calif., according to J. R. Dettman, Air Transport Assn. spokesman here.

Dettman says civil users cannot oppose arbitrary military actions because military agencies hold voting majorities on the Air Coordinating Committee's Air Space Panel in Washington and on regional air space subcommittees.

Operation of about 500 jets from the proposed Naval Air Station would penetrate the six major north-south airways which ATA says are needed to handle air commerce through Central California.

Best remaining hope to forestall Navy action is that farmers interested in keeping the Navy out will hike land prices or that local governments trying to keep land from being withdrawn from their tax rolls will be able to get the problem kicked to top levels in the Eisenhower Administration. The opponents to the air station lost a round last week when the House Armed Services committee approved $30,594,000 for construction of the base.

The Navy originally proposed construction of the base to the Los Angeles Air Space Subcommittee a year ago in two parts. One part covered establishment of the base; the other the establishment of nearby restricted areas for operational training missions such as air-to-ground and air-to-air rocket firing and instrument practice.

Navy later abandoned the proposal for restricted areas because of civilian opposition.

Privately, some lower echelon Navy officers are saying this will make the 32,000 acre NAS Lemoore "a $75 million parking lot." Nearby operational areas are necessary to obtain a reasonable amount of training time out of the short flight duration of jet aircraft.

Civilian air space users are convinced that, if the base is built, Navy later will demand restricted areas on the grounds of making the investment in the base pay off.

There is no reason to suppose this effort would fail if made sometime before the establishment of the proposed Federal Aviation Agency now before Congress.

Under the present system, regional air space subcommittees are composed of voting representatives from the Air Force, Navy, Army, Federal Communications Commission, Civil Aeronautics Administration and the Civil Aeronautics Board. Since the FCC member rarely votes on any subject outside of his own province, there are usually three military votes to two civilian votes on questions of air space assignment.

A military member is not free to weigh the justice of a civilian argument on the basis of his own broad experience. If one of the several commands which he represents opposes the argument on the basis of its own interests, the military member is bound to vote against it.

Since decisions of the subcommittee must be unanimous, civilian members must give in, work out a compromise or toss the problem to the Air Space Panel in Washington. Here, civilian interests are outweighed by a vote of four to three. Again, all decisions must be unanimous and, if no agreement is reached, the problem is sent to the parent Air Coordinating Committee where again civilian aviation interests are also outweighed.

Beyond this, there is the President but in the past the committee has always been reluctant to pass a problem to the White House.

Some compromise is always reached before this is necessary. Many people in civil and military aviation feel the compromise idea has been overworked. Highest consideration so far received by the Lemoore controversy is at the Air Space Panel level.

Many civilian operators in the West say they are weary of the committee approach to executive decisions. They say nearly all current problems facing air space users are rooted in this approach.

Until a single-executive Federal Aviation Agency is established—the present timetable calls for its establishment in three years—the Air Coordinating Committee will continue to settle air space disputes. It is possible that more of the unresolved conflicts will be sent to the President for decision through the newly appointed Presidential Assistant Elwood Quesada who will serve as the new chairman of the ACC if the Airways Modernization Bill passes.

Correction

Sale of 48 French aircraft to the Argentine involved the Morane-Salunier Paris jet powered executive transport not the Fouga Magister jet trainer as reported in AW June 10, p. 23.

Norstad Details 'Accidental' War Chances

By Claude Witze

Paris—Gen. Lauris Norstad, supreme allied commander for Europe, is not optimistic that any clash of NATO forces with the Soviets could be confined to a local war on his eastern front.

His reasoning is simple. The General asks:

"Could the Russians start what they believe will be a local war and accept defeat?

"Could they start a war using small atomic weapons and resist the temptation to add bigger and more potent ones as the fighting progressed?"

In both cases, the obvious reply is negative. Gen. Norstad clearly concludes that if war starts it will be a general war, but he does not believe that Russia is in a position to deliberately start such a conflict. The deterrent is USAF's Strategic Air Command.

Both Gen. Norstad and spokesmen for the U. S. Seventh Army in Germany indicate the sensitive border along East Germany, Czechoslovakia, Greece and Turkey is a key area in this possibility of an "accidental general war." On top of this are the restless satellites, each one a tinderbox. With any outbreak such as the one in Hungary the entire NATO military organization will go on a 24-hr. alert.

In Gen. Norstad's opinion any effort to place a limit on the size of atomic weapons to be used in case of war would only guarantee destruction of the NATO "shield forces" in Western Europe. He points out that the Russians, not NATO, will start any war that breaks out. This gives them the initial advantage which always goes to the aggressor. To take advantage of tactical situations as they develop, the Soviets would be under pressure to throw more and more potent weapons at the Western powers, giving them a new aggressor advantage with each graduation. It would be impossible for the NATO powers to keep ahead and not be guilty of violating any agreement they had made to limit the size of weapons.

SHAPE's chief is confident that support of NATO is undiminished in spirit regardless of what changes have been ordered in military support by some member nations. He says NATO's "assurance" will be cut with the projected loss of 13,500 British soldiers, largely because they are excellent troops.

On the other hand, this will be offset to some degree, starting within a week, as the first three divisions of the new German army are added to NATO's camp. Eventually, there will be 12 German divisions in the total of 30 under Gen. Norstad's command.

So far as airpower is concerned, the NATO tactical force in Europe is five or six times larger than it was in 1951. At that time, when President Eisenhower was boss at SHAPE headquarters here, he had only 21 NATO airfields. They were not modern and were not properly dispersed.

Today, according to Gen. Norstad, there are more than 150 scattered NATO airfields in use; 67 more will be added to the network by the end of 1958. In addition, there is an uncounted large number of airports not under NATO control but available to NATO air forces in event of war.

There is an active program under way to protect these fields and other prime targets with the Nike anti-aircraft missile. The airports themselves have cost NATO from $2 million to $8 million each. In about a year and a half they will be serviced by 8,500 kilometers of new fuel pipelines.

Responsibility for Europe's early warning system was laid on Gen. Norstad's desk only about a year ago. At that time, each border nation was responsible for coverage of its own area. There was no coordination of equipment in types and capability, range was poor, reports were not centralized and long sectors of the border were combed by radar beacons only eight hours a day and five days a week.

NATO now has on order a new radar system comparable to the North American DEW line. It will be capable of tracking aircraft 100 mi. behind the Iron Curtain. Scheduled for completion in 1959, it will operate 24 hr. a day and provide an efficient radar screen, linked to the DEW line and providing added warning for SAC commands located in North America, Africa and Spain.

Despite the fact that he is a USAF officer, Gen. Norstad puts great emphasis upon the importance of NATO's ground forces in Europe. There are some observers at SHAPE headquarters with the opinion that he is more emphatic about this than his predecessor, Gen. Alfred M. Gruenther, Army officer.

Gen. Norstad frankly says that there are "marked weaknesses" in the air defense system and he is working hard to correct them with such things as the new early warning line and addition of the German Air Force with more than 1,300 jet combat aircraft.

Of his ground forces, he says "they are not yet what they should be." And the matter that disturbs him most is the disparity between American weapons and those of our allies, specifically in the field of nuclear delivery systems.

He says the European soldier differs from the American most conspicuously in the tools he uses and indicates that it is up to the United States to correct this situation.

The line between NATO and the Soviet bloc is about 4,000 miles long. Gen. Norstad believes a war could start anywhere on this line should the potential enemy make an error in judgment or take some reckless or opportunistic action.

Because of this possibility he says "we cannot omit or skip at any point along our eastern frontiers the defensive strength which the Soviet threat dictates. . . .

"The enemy might trump up a pretext for crossing the frontier. We would then face not only an accomplished fact but also a dilemma. If we did not take immediate action, we would fail to meet the commitments of the alliance; if we did take it, we would start a war."

From this, it follows that the air and ground defensive forces deployed in Europe are an essential part of NATO's deterrent power.

According to Gen. Norstad, the most perishable asset NATO has is the determination to use this force if the need arises. The will to use it, he says, cannot be produced and stockpiled like atomic bombs.

Sixth Fleet Is Ready, Confident

Palma, Majorca—Despite a meager supply of first-line aircraft, the U.S. Sixth Fleet is confident that it will make a substantial contribution in the event of war.

Vice Adm. Charles R. Brown, Sixth Fleet commander, gives the Soviets 16 hours to knock him out if they are to do it. And, if they try, Brown says, the Soviet effort will open the way for the Strategic Air Command. He adds that SAC would be free to hit the Russians hard if they should throw all they have at the Sixth. He clearly doubts that the Soviets would take this chance.

Contrary to the opinion of most Air Force spokesmen for the U.S. and other North Atlantic Treaty Organization powers, Brown insists that the fleet needs no defense by ground based aircraft.

Such aircraft, he feels, are needed only for adequate early warning and all possible interception over countries such

as Turkey, Greece, Italy and Western Europe.

There is no evidence that he will receive such aid from any forces except those of USAF operating out of Germany and Northern Italy.

The Sixth Fleet today includes the carriers Forrestal and Lake Champlain carrying a total of 135 combat planes, three quarters of them for offensive strikes. The fleet's prime mission, Brown says, is to support land battles in Southern Europe.

The best aircraft for this mission is the Douglas A3D, but Brown has only 12. Another 12 are due soon when the Roosevelt and Randolph replace the present carriers.

The fleet at present has no ground-to-ground or ground-to-air missile capability, but the Terrier-equipped cruiser Canberra is expected soon and the Randolph will carry Chance Vought's Regulus I surface-to-surface missile. The Sidewinder air-to-air missile is carried by the McDonnell Demon and North American Fury.

Other aircraft with the fleet include the Douglas AD, Grumman Cougar and other planes used for early warning, anti-submarine warfare and similar missions.

On top of this, the Sixth sometimes has the aid of a hunter killer anti-submarine force composed of one support carrier and six destroyers. Next visit of the group, which serves with the fleet on a rotation basis, is scheduled for September.

Brown would like to have an anti-submarine unit on duty at all times plus two to four Forrestal class carriers with their necessary support.

Such a move would double the size of the Sixth Fleet, which now has approximately 60 ships, 25,000 men.

Home base of the fleet is Norfolk. Adm. Brown says all local bases are too vulnerable to attack. They also would demand additional personnel, real estate investments and tremendous logistics support.

At present, the fleet keeps only ammunition reserves ashore in the Mediterranean. For economy reasons, however, it purchases fuel in Naples, with tankers shuttling it to the combat ships at sea.

The recent appearance of three Soviet submarines—which have subsequently been presented to Egypt—in the Mediterranean is viewed by Brown as interesting but, in itself, not too important.

He points out that the Russians clearly have the right to sail in the Mediterranean and to show their flag near that of the U.S. flag.

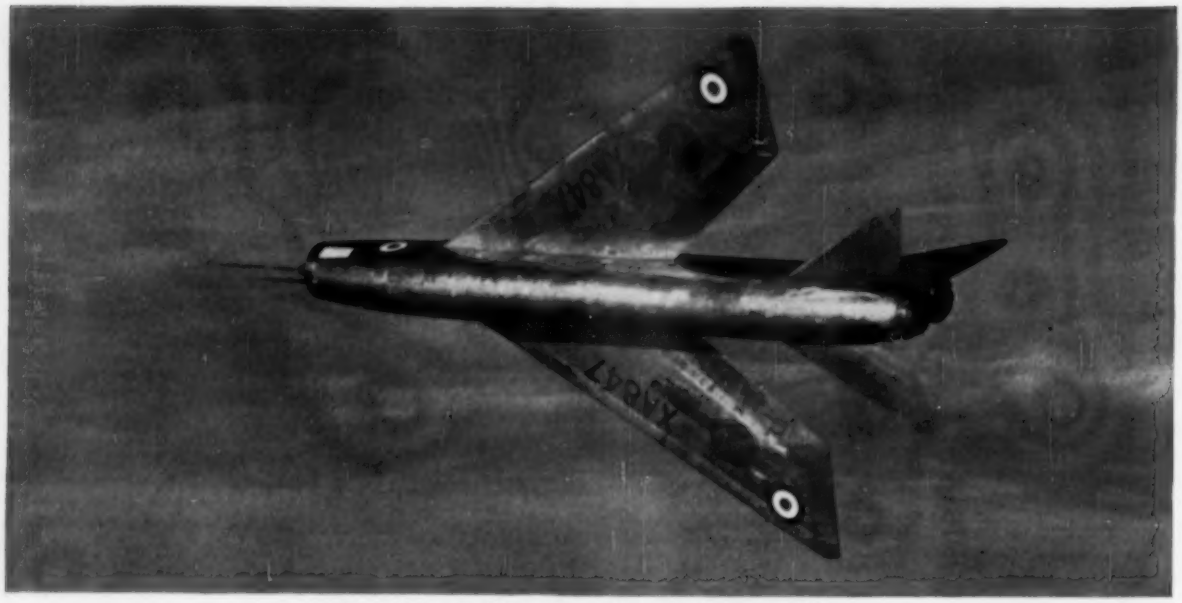
Brown's intelligence officers say the biggest threat to the Sixth Fleet is the Soviet Tu-4 Bull bomber similar to the B-29.

A3D, A4D, F-101 Modified

Most noticeable change in latest Douglas Skyhawk, the A4D-2, is split plate rudder designed to improve control characteristics. Similar rudder is used on North American FJ-4B. Other changes: increased structural strength in fuselage and empennage to take care of new power rudder which has dual hydraulic control; in-flight refueling equipment; single point pressure fueling system for ground. A4D-2 has completed 60-day Bureau of Inspection survey prior to evaluation at NATC Patuxent River and flight deliveries are expected in July. Several hundred are on order.

Changes in Douglas A3D-2 are primarily internal. There is more structural strength, mainly in center wing section. Higher thrust Pratt & Whitney J57-P10 rated at 10,500 lb. is fitted in place of 10,000-lb. J57-P6. Redesigned bomb bay will carry more types and increased numbers of stores and more fuel capacity is provided.

Operational data on its J79 engine is being collected by General Electric with this McDonnell F-101. Douglas F4D, Lockheed F-104 also are used (AW Mar. 18, p. 23). Weight saving in F-101 with J79s installed instead of J57s is approximately 3,500 lb. All three airplanes were photographed at open house at Edwards AFB, Calif.



British P.1B Carries Inlet Spike

First English Electric P.1B reveals some of the changes from prototype including spike in inlet for increased engine swallowing efficiency at supersonic speeds. Center body probably does double duty carrying radar equipment. Intake of P.1B is circular rather than oval as in predecessor. Dorsal spine, which continues added cross sectional area of raised cockpit back to fin, probably is used for equipment storage. Speed brakes have been relocated to top of fuselage near leading edge of fin. Powerplants are two Rolls-Royce Avons, probably RA. 24s rated at 11,250 lb. thrust without afterburner.

Easing of 'Need-to-Know' Rule Proposed

Washington—Sharp curtailment of the "need-to-know" requirement for access to classified information in order to facilitate the flow of technical information among scientists and engineers is being urged by the Commission on Government Security.

The nine-member group—composed of three members appointed by the President, three by the President of the Senate and three by the Speaker of the House—recently completed a year and a half study of the federal loyalty and security programs (AW June 24, p. 39). In its report, it declares:

"The application of the 'need-to-know' policy should occur only on those occasions when there is sound reason to believe that the national security will be adversely affected."

Gardner Testimony

The commission pointed to the testimony of Trevor Gardner, former assistant secretary of the Air Force for research and development, "that scientists, engineers and physicists 'need-to-know' all the facts they can get their hands on, because it is very difficult to ascertain which of them may develop a much needed idea. Applying 'need-to-know' criteria to a scientific situation results in the crippling of progress. It is often impossible to define what a scientist needs to know in order to accomplish his job."

It added, however, that controls under the industrial security program "will always be difficult because of inherent ambiguity of the test—'need-to-know'—and because extraneous considerations tend to become involved, such as the conflict between the general desire to find out what the other companies are doing and the natural reluctance of those companies to disclose more of their processes and techniques than is necessary."

Other Recommendations

Other recommendations on industrial security, which the commission said "should contribute substantially to an improved balance between the need for protection of the national security and the need for free exchange of ideas and information," were:

- **Establishment of an Office of Security** under the Secretary of Defense. The security program of the three military services would be consolidated "into a single, integrated program, devised, controlled, supervised and operated" by this office. Instead of three sets of regulations, there would be one. Military security personnel, including inspectors, would work under and be responsible to the office rather than to their individual services.
- **Company-wide cognizance** by only one government agency. This would expand the present policy within the Department of Defense under which a single service is assigned cognizance over a single facility. It would not only extend the cognizance to a company-wide basis but, in cases where military contractors also had non-military contracts—for example, with Atomic Energy Commission—the company would be assigned to only one agency or department.
- **Security changes would be made** only after consultation with representatives of the industries concerned. The commission ruled out bilateral consent as a "requirement" because this "would necessitate securing the approval of

Criminal Prosecution

Washington—Under a criminal statute recommended by the Commission on Government Security, persons in the government or out who make public the contents of "secret" or "top secret" documents would be subject to a maximum penalty of $10,000, five years imprisonment or both. At present, only disclosures by government employes have been punishable.

a New 400 CYCLE MOTOR

with integral gear box for use in missiles and jet aircraft

EEMCO

technical bulletin

EEMCO Type D-899 is a compact, light weight 400 cycle, 3-phase motor with an integral gear box that operates on 200 volt power. It was designed by EEMCO especially for use in supersonic aircraft and missiles and meets MIL-M-7969-(ASG) specifications. Weighing only 11.25 pounds, it has a continuous output of 2.75 HP at 3140 RPM at the gear box. The power factor is 83% while the overall efficiency of the unit is 76%. Mounting flange is made to Spec. AND-20,000.

A feature in the design of **EEMCO Type D-899** is that the gear box acts as the motor support which places the base at approximately the center of gravity of the motor-pump assembly. This enables the unit to withstand the extreme shocks and vibrations encountered in supersonic aircraft and missiles. With minor alterations, the motor can be made splash- and drip-proof.

Type D-899 is another example of the fine craftsmanship found in all EEMCO products. EEMCO's entire effort is confined to the design and production of linear and rotary actuators and special motors of high-output light-weight ratio. Many of the latest jet aircraft and missiles being developed or delivered carry EEMCO units. EEMCO products are also used for industrial applications where precise control tolerances are imperative.

SPECIFICATIONS OF EEMCO TYPE D-899 MOTOR

Model: 200 volt, 400 cycle, 3-phase.
Load: 2.75 HP continuous output.
R.P.M.: 3140 RPM output at gear box.
Power Factor: 83%
Overall Efficiency: 76% for entire unit.
Military Specification: Meets MIL-M-7969-(ASG).
Weight: 11.25 pounds.
Comments: Type D-899 may be made splash- and drip-proof with minor alterations.

Designers and producers of motors, linear and rotary actuators... exclusively

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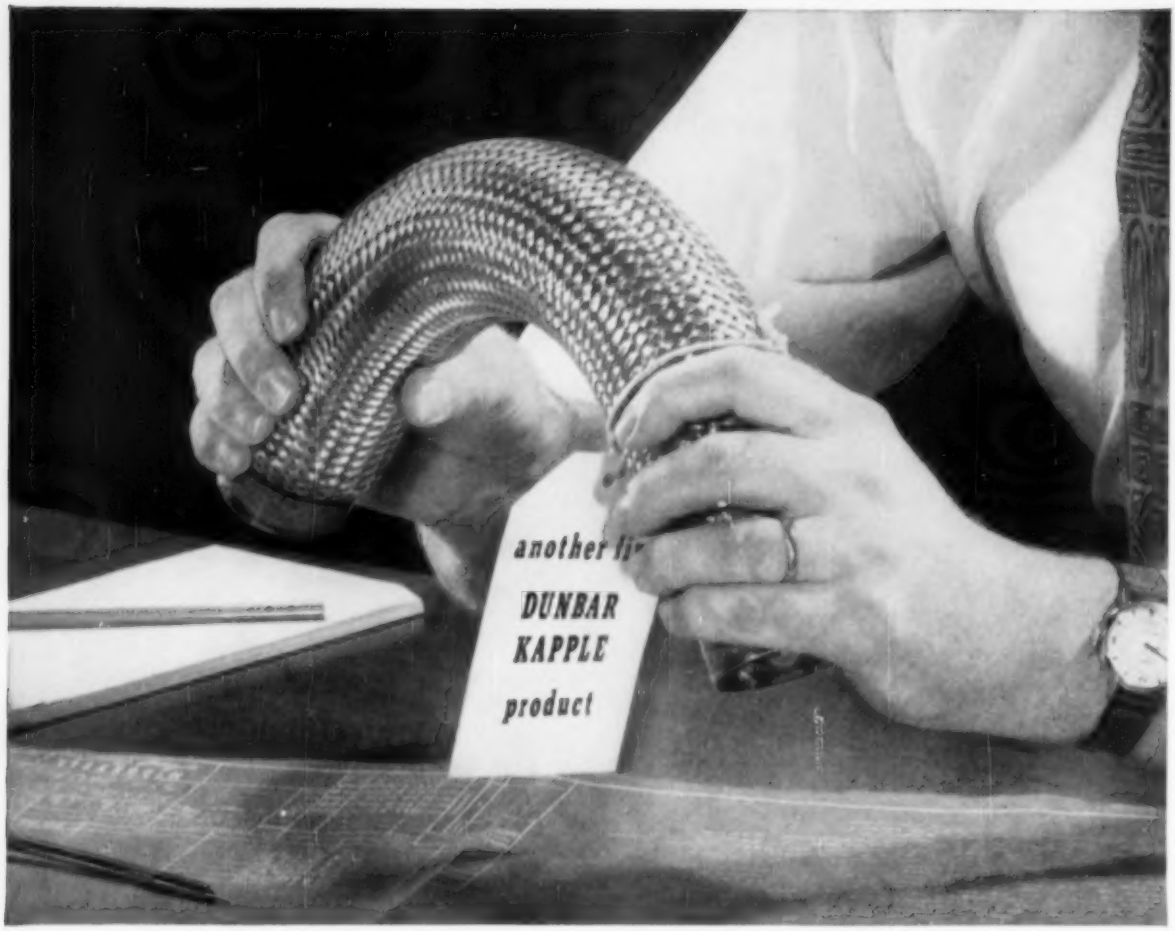

At last a FLEXIBLE Metal Hose

which can replace rubber tubing

Development of a flexible stainless steel hose with a smooth, turbulence-free interior now makes it possible to specify flexible metal hose in places where rubber or synthetic tubing formerly *had* to be used.

This flexible hose, developed and patented by Dunbar Kapple, Inc., has conquered the problems of turbulence and pressure drop heretofore common in convoluted metal hose.

It's now possible to have the strength and corrosion resistance of metal for use in free-flowing Freon, hydraulic, pneumatic or drain lines. Greater dependability and less deterioration are now attainable with flexible metal hose and ducting in places where synthetic and rubber hose usage is marginal because of excessive temperatures and pressures. And, it's at last feasible to refuel at high altitude with a long-lasting flexible *metal* hose.

Smooth flow is assured by special fabrication. An outside retaining braid gives added strength. The flexible metal hose will stand pressures from vacuum to 1300 p.s.i. and up. Inside diameters are ¾-inch to 6 inches and up with lengths from 1-inch to 100 feet.

For further information . . . write in confidence to Batavia or: Russell Engineering, 2205 Grand Avenue, Kansas City; 2140 Westwood Boulevard, Los Angeles; C. F Russell & Company, 146 4th Avenue, Bay Shore, Long Island. Your inquiry will receive prompt attention.

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every contractor with which the government has an industrial security contract."

• **Abolition of the "confidential"** classification for all future documents. Documents already classified "confidential" should be made available to industry employes without clearance. Later, there would be a gradual review for declassification of the documents.

Declaring that the classifications of "secret" and "top secret" are adequate to protect the national security, the commission said that many documents now classified as confidential "could be so classified only by the greatest stretch of the imagination." It noted that 59% of all of the classified material of Department of Defense is now listed in this category.

Any wholesale upgrading of "confidential" documents, the commission said, would be admission of previous "gross dereliction" in classification. It added:

"Only a minimum amount of upgrading of documents would be necessary.

"Any risk involved in the abolition of confidential, so far as the industrial security program is concerned, is minimized by the fact that the various industrial phases of a confidential contract are so dispersed as to make it virtually impossible for any employe to assemble the information to the detriment of national security."

The commission also declared that there should be no censoring whatever of unclassified information. It endorsed the recent abolition of Commerce Department's Office of Strategic Information established to control the flow of unclassified technical information, observing: "Except in time of war there should be no agency of government censoring unclassified information and materials. It is unrealistic to believe that technical publications and catalogs of American industry, available to the public in the U.S., would not be available to agents of foreign governments."

Navy Wants Industry to Share Burden of Solion Development

By James Fusca

Washington—Exploitation by industry of Solions, a new and versatile family of electronic components, is being urged by the Naval Ordnance Laboratory.

Creation of a commercial market for these electro-chemical devices, whose operation is based on the movement of ions in a solution, will accelerate their development, lower costs and increase availability to the Navy, the Laboratory believes.

Solions, the name a contraction of "ions in solution," will function as transducers and control elements throughout a wide range of applications, according to Navy physicists. They are small, lightweight, and highly sensitive to temperature, pressure, light, sound or acceleration.

One type of Solion, an integrator about the size of a demitasse cup, may permit major size, weight and cost reductions for air navigation and inertial guidance systems.

A navigation system designed to use electrochemical integrators would be capable of instantly sensing directional changes about all three axes and determining distance and time-to-go drive indicators and control mechanisms. The inertial principle on which the integrator works gives it what is in effect a "memory" of the original course which would permit a pilot or missile guidance system to correct quickly any deviation.

One of the earliest anticipated uses for the Solion technique is for a visual exposure meter to protect personnel working near jet aircraft. Exposure to the low frequency acoustic signals of jet engines over an extended period can cause deafness. The device would measure the cumulative effects of the sound and visually indicate the total dose by a change in color of the solution.

The general areas of application:

• **Rate circuits** of all descriptions whether operated from temperature, pressure, electrical or other sources.

• **Integration units** requiring continuous readout of high precision or over long periods.

• **Product circuits** involving either electrical derivatives or hydraulic flow.

• **Electrical** and small signal amplifiers.

Basic research on the Solion technique has been performed by the Naval Ordnance Laboratory and the Defense Research Group of the University of Texas.

Several of the staff members of the Defense Research Group have formed a corporation (Texas Research Associates Corp., Austin, Texas) and are presently seeking contracts from industry to develop Solion devices for commercial applications.

All of the several different Solion types depend upon the movement of ions (electrically charged atoms or molecules) in a solution, instead of in a vacuum or gas as in the vacuum tube, or in a solid as in the transistor.

The integrator unit is typical of the seven or eight types of Solions presently developed. It consists of a small cylinder divided into two sections by a porous ceramic filter. Two electrodes are immersed in a solution of potassium iodide to which a small amount of iodine has been added. A low voltage battery supplies an initial bias of slightly less than one volt. By electrolytic action, the concentration of iodine in one chamber of the cylinder will change as iodine, which cannot penetrate the filter, is converted to iodide, which can. An approximately linear increase in current flow takes place with an increase in the iodine concentration.

News Digest

Lockheed C-130 Hercules will be tested this summer by Marine Corps as possible tanker for inflight refueling. Lockheed's Georgia Division has been given contractual coverage by USAF to modify one airplane for the tests at Patuxent River, Md. A second airplane will be tested by Marines as a troop cargo transport.

World wide demand for jet aircraft fuel now is higher than that for aviation gasoline, California Texas Oil Co. reports. In the last five years, world demand for jet fuels rose from 15 to 105 million barrels a year, but aviation gasoline consumption rose only 40%, from 73 to 102 million barrels.

Solar Aircraft Co., which ran up losses last year because of a strike and production shifts, ended its fiscal year April 30 with a $384,981 profit, equal to 55 cents a share. Last year the company earned $1,252,608 or $1.82 a share. Sales for the fiscal year totaled $83 million, an increase of 61% over last year. Backlog was $91 million at the year's end.

Ryan Aeronautical Co.'s X-13 Vertijet is being transferred from Edwards Air Force Base to an eastern USAF base by ship via the Panama Canal. Test pilot Pete Girard is due to go east in the near future as well. In the meantime, two USAF AFFTC test pilots are starting VTO training at the tether rig at Ryan's San Diego plant, preparatory to checkout in the X-13 itself.

Northrop Aircraft, Inc. earned $1,313,331, equal to 86 cents a common share, in three months ended April 30. For the same period last year, earnings were $1,114,634 or 74 cents a share. Sales for the 1957 three month period were less than last year, $69 million compared with $86 million.

Carriers Want New Continental Route

Two airlines hope to turn Dallas-to-the-West case into opening for southern transcontinental route.

By Craig Lewis

Dallas—Hearings were completed here last week in a Civil Aeronautics Board route case that could produce another transcontinental trunk airline.

Month-long hearings before CAB Examiner Thomas L. Wrenn in the Dallas-to-the-West service case were confined strictly to the issue of service between Dallas and Ft. Worth and West Coast points, but other factors involved could mean the establishment of another cross-country airline.

Two carriers are fighting to turn the case into a southern transcontinental case. And even if the CAB succeeds in limiting the case to the Dallas-California route, such a route would complete a transcontinental route pattern for another pair of airlines in the case.

At present, American Airlines has a monopoly on Dallas-West Coast service in the Dallas-to-the-West case, seven trunk airlines are trying to break this monopoly and add the route to their systems.

What Case Involves

The case involves the establishment of competition on a monopoly route, and several of the applicants are the smaller trunklines the CAB has been trying to build up in a series of major route cases. Thus, the case presents a classic test of CAB's recent policy of expanding competition by building the smaller trunks into stronger competitors of the big four.

The route involved in the case serves the expanding air travel market between Dallas and Ft. Worth and Los Angeles and San Francisco/Oakland. It also provides east-west service to points in Texas, New Mexico, Arizona and Nevada. Here are the carriers asking for the route and the arguments they are using to back their applications:

- **Delta Airlines** claims a historical interest in the growing Texas-California market through its interchanges with American and argues that the back-up traffic from Delta's system east of Dallas would make it the strongest competitor on the route. Delta also points to the advantages of linking military establishments in the southeast and southwest with a one carrier service.
- **Braniff Airways** argues that the route needs competition and that Braniff is in a position to offer strong competition to American. The carrier also points out that it could offer new one carrier service between the West Coast and Houston and points on its South American routes.
- **Eastern Airlines** wants the Dallas-West Coast route but thinks it should be considered as part of a southern transcontinental route case.
- **National Airlines** also thinks the route case should be expanded but is applying for Dallas-West Coast route so that it will be ready to provide southern transcontinental service when the CAB gets around to dealing with such a route.
- **Continental Airlines** points out that it is already operating in the area, that the route fits easily into its system, that it serves cities at both ends of the route and that it will have turbine powered aircraft ready when the route is awarded.
- **Western Airlines** says that, as a regional carrier concerned only with the Dallas-West route, it would provide better service than a carrier concerned with serving eastern points on flights operating over the new route.
- **California Eastern Aviation** also argues that a regional carrier would do a better job of tailoring its service to the specific needs of the Dallas-California route and that its Lockheed Super Constellation, Vickers Viscount and Convair 880 transports would be ideal for future operations over the route.

The Dallas-to-the-West case stems from an application filed by the City of Dallas for better service to the West Coast. Dissatisfied with the service provided by American, Dallas launched a campaign to improve it as soon as the important Northeast-Southwest service case was completed at the end of 1955.

Dallas was joined by seven intermediate cities along the route in presenting joint exhibits to the Board, and a dozen cities appeared at the hearing to encourage the CAB to establish more service in the area.

Last year, a maze of complicated applications were filed for consideration with the Dallas application. Together they covered service to practically the whole nation, but the most important were those for new routes between Florida and the Southeast and the West Coast through Texas.

CAB rejected those applications to broaden the scope of the case, and last September it confined the issues strictly to the route between Dallas and California. It was a split decision with two CAB members favoring consideration of service to points east of Dallas.

At the same time, the Board said that any new service would have a restriction requiring flights coming from points east of Dallas to stop at Dallas. Also, flights serving California points on the new route would have to serve Dallas. Later these two restrictions were amended to allow the new carrier to serve either Dallas or Ft. Worth.

To concentrate on the long-haul Texas-California aspects of the case, the CAB also has excluded issues of service between San Diego and Las Vegas, Phoenix and Las Vegas, Phoenix and Albuquerque and between Tucson and Albuquerque.

When the CAB took steps to avoid a southern transcontinental service case, Eastern and National took strong exception to the decision. The route systems of both carriers stop at Houston, leaving a missing link between Houston and the eastern terminal of the route between Dallas and California.

Arguments Continue

Both carriers are staying in the case with applications for Dallas-West routes, but their main efforts have been bent toward persuading the CAB it should expand the case.

They argue that the granting of this new route to another carrier will damage their position when the Board does consider a route between California and the Southwest.

Both Eastern and National are continuing their arguments under the Ashbacker Doctrine that granting of an application in the limited Dallas-to-the-West case would preclude granting of one of the excluded applications. Eastern has said it will go to court on this basis if another carrier is granted the Dallas-West Coast route.

National is already in court. Before the CAB hearing began, National asked the U. S. Court of Appeals to order the hearings delayed until the matter was decided. The court refused to delay the CAB hearings, but it is giving National an expedited hearing. If it decides in National's favor and orders the case expanded to include the southern transcontinental issue, more hearings are inevitable.

Actually, although CAB confined the case to the Dallas-California route segment, the issue of transcontinental service is lurking in the background. This stems from the fact that both Braniff

and Delta have routes to New York, and Delta has an extensive system in the Southeast. Both carriers say that the restrictions requiring a stop at Dallas would take them out of the transcontinental market because they could not compete on schedules with nonstop operators.

But observers point out that restrictions have had a historical way of being lifted after a few years.

Certification of Delta on the new route would probably have the most far reaching effects. The carrier is already involved in through service to the West Coast through an interchange with American from Atlanta, Birmingham and New Orleans to the west via Dallas. Delta, National and American also operate an interchange between Florida and California via New Orleans and Dallas.

These interchanges came out of the reopened Southern Service to the West case decided several years ago.

Advantages for Delta

With this interchange experience and with the back-up traffic from its system east of Dallas, Delta has the resources to provide strong competition to American. Also, when the time came to choose a carrier to operate nonstop between California and Florida and the Southeast, Delta would be established in all the markets and would need only a new segment across the Gulf of Mexico and the lifting of restrictions to operate the service.

If Delta is not chosen for the route, it poses an added competitive hazard for the carrier that does get it. The new carrier would not only have to compete with American's considerable resources but would also have to compete with the back-up traffic provided to American by the National and Delta interchange services.

These interchanges are not involved in the case, and it would take another CAB proceeding to change them. But if Delta gets the route, they aren't likely to last too long in view of the fact that Delta would in effect be competing with itself while the interchanges continued to operate.

Very likely, Delta and National would attempt to establish an interchange at New Orleans to replace the present three-carrier interchange between Florida and California.

CAB could minimize the transcontinental complications of the case by giving the route to Western, Continental or California Eastern, none of which could provide transcontinental service with the new route. This factor could work in favor of these three carriers.

Another factor favoring the choice of one of the smaller carriers is the CAB policy developed through a series of major route decisions starting with the New York-Chicago case in 1955. In these cases, the Board has awarded major new routes to the smaller carriers with the stated purpose of strengthening them and cutting the tremendous gap in size between the smaller trunks and the big four.

Both Delta and Braniff benefited from this philosophy when they were awarded routes into the valuable New York air travel market. Continental won a new Los Angeles-Chicago route, and Western and National have benefited to a lesser degree. The Dallas-West case provides a number of smaller trunks to help if the CAB wants to stick with this leveling policy.

CAB faces another major policy decision in the case of California Eastern. The carrier is not a certificated scheduled airline, although it does have extensive airline experience gained in military contract operations. Cal Eastern is also affiliated with Transcontinental, S. A., an Argentine airline.

In considering California Eastern for the Dallas-California route, the board will have to go into the right-of-entry questions raised so often in past route cases by Trans American Airlines. Trans American was an applicant in the Dallas-West case until the CAB and the courts put the carrier out of business for violations of the Civil Aeronautics Act.

American's Defense

The Dallas-West Coast market is large enough to make new competition for American on the route seem almost inevitable, especially in view of the Board's recent trend toward expanding competition in major route cases. American is defending its service on the route and contending that there is no need for more service.

To strengthen its own position on the Dallas-California route and to get into a new high density market, American is asking the CAB to close the ends of its routes to the West Coast. Presently, American has separate routes to San Diego and Los Angeles and to San Francisco.

This move would put American into the heavily traveled Los Angeles-San Francisco market, and carriers now operating on the route are protesting strongly. These carriers are also ap-

Emperor Inspects His Constellation

Bearded Emperor of Ethiopia, Haile Selassie I, inspects the Lockheed 749 Constellation he will share with Ethiopian Airlines. His stateroom (with royal arms, right) will be converted for passenger use when the airplane is utilized in regular service by the airline.

prehensive about any new carrier on the route getting authority to operate over the Los Angeles-San Francisco link.

Southwest Airways has proposed that the Board impose a closed door restriction on a new carrier or else certificate separate routes to San Francisco and Los Angeles similar to American's present authority. Certification of separate routes to the two California points could conceivably encourage the CAB to name two new carriers for Dallas-West service—one for each of the routes.

Trans World Airlines and United Air Lines took part in the hearings, although neither has an application in the case. Both TWA and United were defending their right in the Los Angeles-San Francisco market. TWA also defended its service at some of the intermediate points between Dallas and California.

SAS Order for 6 Caravelles, Options for 19 Is Reported

Paris—Scandinavian Airlines System is reported ready to order six twin-jet Caravelle transports and to option 19 more.

The French jet returned here June 24 via the North Atlantic after completing a sales tour of South and North America which began May 2 and included 94 demonstration flights with 3,000 passengers carried. No firm orders were announced as a result of the 27,731-mile junket, but Paris sources expect the SAS order to touch off a string of orders pending on both sides of the Atlantic.

U. S. Order

The six SAS Caravelles would be delivered during the first half of 1959. This would mean Air France—the only announced Caravelle buyer, with 12 ordered and 12 optioned—probably will have to turn over some of its planes to SAS. Air France's initial Caravelles are scheduled for delivery in early 1959.

It is understood an agreement has been signed between Air France and SAS covering operation of the jets on the Paris-Stockholm run.

Caravelle's U.S. tour covered 17 cities and the plane was inspected by officials of most scheduled airlines in the country. Pacific Southwest Airlines announced it would order two Caravelles, option one within the next two or three months for West Coast operation.

Varig, a Brazilian airline, said it planned to order five Caravelles.

U. S. Tour

The French jet returned to Idlewild June 19 and flew two final U. S. demonstration flights, carrying top officials of Eastern Air Lines and American Airlines. The plane went on to Montreal for Trans Canada Airlines inspection, then crossed to Orly after a stop at Gander.

The 2,200-mile flight from Gander was accomplished in six hours, 20 minutes and put the plane back where its tour started within minutes of the original schedule for the windup of the tour.

Caravelle's side trip to Culver City, Calif., for inspection by Howard Hughes, touched off reports that Hughes would build the plane in this country, but no acknowledgement of such negotiations was made by Sud Aviation.

Claude J. Teyssier, Sud general representative for North America, said during the Caravelle's West Coast visit that Republic Aviation would build the planes if enough orders were obtained in this country.

Four per Month

Caravelle production will reach at least four aircraft monthly by the beginning of 1960, according to Sud Aviation President Georges Hereil. At least 15 of the aircraft are expected to be built in 1959.

An agreement has been signed between Sud Aviation and Fiat of Italy under which the Italian firm will participate in Caravelle production. Similar agreements are reported to have been signed with other European manufacturers.

TWA Viscounts

Howard Hughes will buy the 15 Vickers Viscounts released by Capital Airlines, Aviation Week learned from a West Coast source. Hughes recently flew to Montreal with a TWA group to fly a Trans-Canada Air Lines Viscount, leading to speculation that he would pick up the deferred Capital planes (AW June 10, p. 32).

Last week Hughes was still in Montreal and the TCA plane was still at his disposal. He has made a number of local flights in the Viscount, talked to TCA officials and operational personnel.

While the chief TWA stockholder has ordered a personal Viscount for his own use, presumably the extended inspection of TCA airline operation of the plane ties in with the expected TWA order.

Argentine Line Seeks Route to New York

Washington—Civil Aeronautics Board Examiner Ferdinand Moran has recommended approval of an application by the Argentine Airline Transcontinental, S. A., to operate scheduled service between Argentina and New York under a technical assistance agreement with California Eastern.

In its petition, the airline proposes to operate the route with a fleet of three Lockheed 1049H Constellations which have been made available under the terms of a lease-purchase agreement with California Eastern.

The airline also has four Convair 880 jet transports on order (AW Oct. 29, 1956, p. 42; Nov. 26, p. 37).

Under the terms of the agreement, Transcontinental will be provided technical assistance by California Eastern for 60 months. This assistance will include arrangements for the operation, maintenance and overhaul of aircraft until these functions can be handled by Transcontinental.

As consideration for the technical assistance program, the airline proposes to issue a 25% stock interest to California Eastern. The arrangement provides for an option permitting California Eastern to purchase enough stock to maintain its 25% ownership in the event Transcontinental desires to increase the number of shares outstanding.

In its application, the airline says technical and management assistance needed to conduct operations of the size and scope of the proposal is not available in Argentina. It added that if California Eastern is not permitted to collaborate in the development of the proposed route, the airline would consider offers from European manufacturers such as Sud Aviation or Bristol or else seek assistance from Lufthansa, Air France or Bristol Overseas Airways Corp. for the assistance it needs.

Transcontinental is financed and operated as a private enterprise, according to the CAB examiner. At present, Aerolineas Argentinas, a wholly-owned government airline, operates service to New York from Buenos Aires and transatlantic flights to Europe from Argentina.

Transcontinental proposes to inaugurate the New York service with three roundtrips weekly.

It estimates that traffic will average 60 passengers per flight, or 18,720 passengers per year.

The three Lockheed Constellations will be designed with a configuration of 82 tourist class seats. Crews for the flights will be provided by California Eastern.

Player to Leave ATA

Washington—Willis Player last week resigned from the Air Transport Assn. as vice president-public relations to accept a similar position with American Airlines. He will be succeeded by John F. Hoving, who has been elected vice president of public relations by the ATA Board of Directors. Player's title with American Airlines has not yet been determined, but he will take over his new position in New York City in September. He joined ATA in 1954 after having served as vice president-public relations with Northwest Airlines and, earlier, as public relations director of Pan American Airways.

Hoving, 33, joined ATA in May, 1956, and has been serving as director of public relations. Previously, he was a partner in the New York City public relations firm of Pendray, Cook & Hoving. He also has served as assistant to the chairman of the Democratic National Committee.

TWA Is Replacing Hollow Blade Props

Hollow-blade Hamilton Standard 43H60 propellers on TWA's Lockheed 1649A Jetstream fleet are being replaced by solid dural blades following a recent weld failure of a hollow blade.

The weld failed shortly after takeoff of TWA Flight 932 en route to Milan from Paris. Following the failure, a portion of the blade filler was flung from the tip region and penetrated the airplane cabin at the lavatory. The engine was shut down and the flight returned to Orly.

The airline is studying possible return to the hollow aluminum blade, which offers a 600-lb. plus weight advantage over the solid version. Solid blade is backup equipment for 1649 operators. Hollow blade is standard.

Correction

Washington—Civil Aeronautics Board has not directed that a cease and desist order be issued against Trans-Continental Airlines Agency Corp. as reported by AVIATION WEEK (June 10, p. 47).

Proposal that such an order be issued against the agency was made by Bureau Counsel Edwin F. Stetson, but the Board has not taken action on the recommendation. Stetson's proposal is now being reviewed by a CAB examiner who will report his findings to the Board.

The list of alleged violations of the Civil Aeronautics Act by Trans-Continental also was made by the Bureau Counsel and not by the CAB as reported by AVIATION WEEK. AVIATION WEEK regrets the error.

Russian Transports

Ilyushin 14 (top) is shown in flight and in production. Soviet transport is powered by two 2,600 hp. ASh-82T, 14-cylinder, radial air-cooled engines. Standard seating accommodates 27 passengers. Larger Ilyushin 18 (note salon, below) will carry 70 passengers; has a low-mounted swept-back wing and four turboprop engines (AW July 2, 1956, p. 26).

American Airlines Recommended For Chicago-Mexico City Route

Washington—American Airlines was recommended last week by Civil Aeronautics Board Examiner John A. Cannon for a nonstop route between Chicago and Mexico City under terms of the U.S.-Mexico air transport agreement signed this spring (AW March 18, p. 45). Both American and Braniff International Airways sought this route.

The recommendation was made to the Board which, in turn, will make its recommendations to the President for final approval.

American now holds a permit from the Mexican government to operate between Dallas, Fort Worth, San Antonio and Mexico City and has been operating such service since September, 1942.

Braniff also has been certificated to provide service between San Antonio, Laredo and Mexico City but has been unable to implement the service because of lack of authority from Mexico. Neither has authority to fly nonstop between Chicago and Mexico City although both could operate through service via intermediate points.

Even though the Mexican air agreement permits only one U.S. carrier to be designated for each of the seven routes, Examiner Cannon recommended that Braniff's certificate remain in force in the event more than one carrier can eventually obtain authority to conduct U.S.-Mexico operations over the route.

The only other route agreed upon under the Mexican bilateral still open is the New York-Washington, Mexico City route. In this proceeding now pending before the Board, Pan American World Airways has been recommended over Eastern Air Lines.

Airlines already designated for routes are:

- **Western Airlines** to operate between Los Angeles and Mexico City via intermediate points in the U.S.
- **Eastern Air Lines** to serve between New Orleans and Mexico City.
- **Pan American** to operate between New Orleans-Merida and beyond, to Guatemala and beyond.
- **Pan American** to operate between Miami-Merida and beyond, to Guatemala and beyond.
- **Pan American** to operate between Houston, Brownsville-Tampico, Mexico City, Tapachula and beyond to Guatemala and beyond.

In recommending American for the route, Examiner Cannon said: "During the 15 years of pioneering in Mexican aviation, American had done much to foster good will for the U.S. in Mexico.

". . . There is no reason to believe Braniff could not establish good relationships in Mexico and during the course of time develop traffic and other activities comparable to American. The fact remains that American is an established airline in Mexico City, having extensive facilities and good will, all of which would be lost if its operations are terminated.

"At the very least, termination of its authority would result in some hiatus in service and traffic until the newcomer is able to make the same contacts and build up its organization. In view of the foregoing considerations, it is concluded that the public interest could be best served by selecting American to provide service over that route."

Swiss Vote Clouds Swissair Jet Plans

Geneva—Zurich's Kloten Airport expansion, geared to the introduction of jet transports by Swissair in 1959, has been voted down by a resounding majority in a public cantonal referendum.

Plan called for the expenditure of $42.5 million over the next five years to lengthen the runways and provide new terminal maintenance and overhaul facilities for Swissair.

Defeat of the measure by a large rural vote surprised both government and airline officials, as the first $10 million in construction contracts was ready to let immediately.

Switzerland's government office for air traffic argued before the referendum that refusal of the proposal by voters would mean that the airport would be able to retain only continental traffic. Long-range flights presumably from across the Atlantic would have to go elsewhere.

Swissair, one of the top producers of income for Switzerland, says it will still be possible to schedule some of its transatlantic flights out of Zurich, which now has an 8,500 ft. instrument runway. These would be one-stop flights going from Zurich to Geneva or another European city. But nonstop transatlantic hauls will pose a problem which the airline is now studying in a thorough examination of its flight scheduling for the future.

Vital part of the plan was the provision of new facilities for Swissair at Zurich. The city's airport at nearby Kloten is now the headquarters and operations base for the airline. Present space is inadequate for jet maintenance and was to have been approximately doubled with the addition of hangar space, shops, cafeteria, and school facilities. Cost of the new facilities was estimated at $11.6 million.

Defeat of the proposed expansion means that Swissair must find an alternate solution to its future problem of jet overhaul and maintenance. Uprooting of the base to Geneva, this country's other big international airport now proudly carrying through its expansion program, seems to be one possibility. But some observers believe that Zurich would resort to almost anything to keep from losing the income poured into the area by Swissair employes.

There is also the possibility that backers of the expansion scheme may revise their plan to allow for a staged financing which could be voted yearly, instead of asking for the authorization of the complete funding in advance.

About one-third of the needed funds were to have been supplied by the canton of Zurich with the remainder coming from the Swiss federal government. Most informed opinion believes that the vote was not so much against the use of money for expansion of the airport as it was in favor of using money to improve the road network around Zurich. A large faction also felt the airport funds should be voted on a step-by-step basis rather than all in one piece.

Farmers around the airport whose land would be bought for runway extensions argued that regardless of the price paid, they could not buy equivalent acreage. First, land is just not that available here and, second, speculation has driven up the price of the tiny parcels on the market.

Britannia Confirmed As Aeronaves Choice

Purchase of two Bristol Britannias by Aeronaves de Mexico has been announced by Bristol, confirming an AVIATION WEEK report that the airline had ordered the British turboprops several months ago (June 3, p. 438). Aeronaves will use the 300-series Britannia on its newly authorized New York run.

Reported value of the order is $8 million. The planes, scheduled for delivery this year, are nearing completion at Short Brothers and Harland, a Bristol Associate in Ireland. The two Britannias were released by British Overseas Airways Corp. and replacements will be delivered later to BOAC.

Order brings total Britannia sales to 70. Peter Mansfield, Bristol managing director, previously has set 80 aircraft as the Britannia's breakeven point.

Aeronaves recently was awarded the nonstop New York route by Mexico.

Local Lines Push Guaranteed Loan Plan

By Ford Eastman

Washington—Government guaranteed loans to help finance new equipment would eliminate one of the most serious problems now facing local service airlines.

Carriers' difficulties in obtaining financing for new equipment were outlined last week before the Senate Interstate and Foreign Commerce Committee during hearings on Senate Bill 2229 which would provide government guaranty of private loans to air carriers for the purchase of aircraft and related equipment.

It is one of three methods before Congress designed to aid the local service industry.

Other bills yet to be considered by congressional committees are:

- **Capital gains bill** which would permit airlines to set aside profits from the sale of equipment to be used for the purchase of new equipment rather than using it as an offset against subsidy. A similar capital gains bill passed the Senate last session but failed to clear the House.
- **Bill to amend** the Federal Bankruptcy Act to permit lenders to take possession of aircraft and other equipment in the event of bankruptcy without being affected by various other provisions of the act.

Obsolete Equipment

Witnesses told the committee that present equipment used by most local service airlines is obsolete and uneconomical to operate, and that banks are not interested in making loans for new aircraft because of the airlines' poor financial standing.

James R. Durfee, chairman of the Civil Aeronautics Board, sponsor of the legislation, said new aircraft are now being developed which the industry believes will be more economical and efficient and betted adapted to the needs of local service carriers.

He added, however, that the cost of acquiring such aircraft probably will be so great that they will be unavailable to the typical local service and short-haul carrier on reasonable terms without governmental assistance of some kind.

Under terms of the bill, the government would guarantee the lender against loss of principal or interest up to 90% on any aircraft purchase loan. The limit of loans to any one airline could not exceed $5 million and would have to be repaid within 10 years.

The bill also designates the CAB, as the administering agency with respect to all of the various financial phases of the loan guarantee program.

Also appearing before the committee in support of the bill were Joseph P. Adams, former CAB member and now general counsel for the Assn. of Local and Territorial Airlines; John A. Burns, Territorial delegate to Congress from Hawaii, and Jack Frye, president of the Frye Corp.

Airline representatives favoring the bill included G. Robert Henry, executive vice president, Bonanza Airlines; David A. Benz, executive vice president, Aloha Airlines; Sigurd Wien, president, Wien Alaska Airlines; Keith Kahle, president, Central Air Lines; G. Hamilton Beasley, executive vice president, West Coast Airlines, and H. W. Robinson, board chairman, Alaska Airlines.

A statement also was presented in behalf of Robert Reeve, president of Reeve Aleutian Airways.

Bills' Benefits

Witnesses agreed that the proposed legislation would serve a two-fold purpose.

First, they said, it would provide modern flight equipment for the benefit of the public on routes where the use of obsolete planes is the only choice now.

G. Robert Henry, Bonanza vice president said, "As things now stand millions of people in about 500 cities utilizing the air services of local and territorial airlines are pretty largely condemned to flying in obsolete, hand-me-down trunkline equipment that was developed 22 years ago."

The second purpose the proposed legislation will achieve, the witnesses said, is a drastic reduction in subsidy payments now required for the industry. Airlines feel that new modern equipment will not only be more economical to operate, but that such improved service will generate more traffic as well.

The airlines spokesmen said, however, that they do not believe subsidy would be eliminated by an equipment replacement program alone.

Also needed, they said, is a strengthening of the route structure of local and territorial airlines.

DC-3 Promotes Subsidy

Joseph Adams, ALTA general counsel, told the committee a study by an aviation consulting firm shows that it is absolutely impossible for local service carriers to be free of subsidy as long as the DC-3 is the backbone of their equipment fleet.

Adams said the study revealed that the DC-3 has costs of $1.07 per mile, while the local service carriers have only been able to generate 59 cents of revenue to cover these costs. In order to break even, he said, local service airlines would have to realize a load factor of 78% or more. Trunk lines serving the highest density markets realize a load factor of approximately 65%.

Adams said the study also shows that local service carriers have done a remarkable job in keeping DC-3 operating costs low.

Despite the fact that they operate with an average flight of only 76 miles, their costs are lower than those of the trunk lines which still use DC-3s on longer flights.

DC-3s were acquired by airlines at costs ranging from $25,000 to $125,000. New aircraft to replace the DC-3 will range from an estimated $500,000 to more than $1 million. Bonanza Airlines, for example, said it had three Friendship F-27 turboprop transports ordered at a cost of $625,000 each and with only part of the financing arranged.

The airline will need up to 12 such aircraft to fully convert to a modern fleet.

While carriers in the ALTA group strongly support the guaranteed loan bill, other local service carriers, mostly members of the Conference of Local Airlines from which ALTA split (AW April 1, p. 38) favor either capital gains or an amendment of the Bankruptcy Act as an answer to the problem.

None of the local or territorial carriers have indicated opposition to any of the three proposals however.

Bankruptcy Bill Hearings

House Judiciary Subcommittee headed by Rep. James B. Frazier, Jr., (D.-Tenn.) held hearings last week on the Bankruptcy Bill. Witnesses included John Floberg, chairman of the Conference of Local Airlines, and representatives of individual carriers.

Some carriers indicated that neither the Bankruptcy Bill nor the Guaranteed Loan Bill would provide the complete answer to the carriers' re-equipment programs unless the Capital Gains Bill was also passed.

The carriers explained that before they can receive any loan they must have a sufficient amount for a down payment on equipment. Few lines have this at the present time.

The Capital Gains Bill would permit the carriers to retain profits accruing from the sale of equipment and this would provide the necessary down payment.

Airline Income and Expenses—April, 1957

(In Dollars)

	Passenger Revenue	Mail Revenue	Express Revenue	Freight Revenue	Total Operating Revenue	Total Operating Expenses	Net Operating Income (before taxes)
DOMESTIC TRUNK							
American	21,853,762	571,694	285,274	1,373,352	24,487,451	23,112,721	1,374,730
Braniff	4,023,827	106,408	38,187	100,188	4,345,847	4,272,135	277,656
Capital	7,177,395	143,235	60,432	83,358	7,574,629	7,414,002	160,627
Continental	1,437,221	39,318	11,082	34,029	1,600,540	1,525,465	75,075
Delta	6,374,381	133,043	67,394	172,550	6,896,010	6,067,745	763,867
Eastern	22,085,688	356,088	767,560**	.....	23,319,944	21,260,092	2,024,972
National†	5,393,307	96,295	22,712	134,662	5,868,929	5,097,995	772,957
Northeast	2,760,301	43,787	28,482	64,870	3,715,938	4,791,513	−1,064,529
Northwest	3,486,956	137,844	325,371**	.....	3,995,072	4,279,414	−284,341
Trans World	13,452,755	392,228	821,733**	.....	15,033,385	15,503,830	−470,445
United	18,379,258	72,392	248,330	876,236	20,386,050	20,854,491	−468,873
Western	2,859,194	84,241	32,000	65,672	3,098,036	2,772,228	293,793
INTERNATIONAL							
American	409,032	4,671	124	59,667	499,354	487,506	11,848
Braniff	479,403	98,959	.....	24,217	648,315	554,263	87,795
Caribbean-Atlantic	167,816	1,946	5,635**	.....	181,176	149,974	31,090
Delta	437,728	4,642	.....	19,754	486,283	456,830	26,551
Eastern	1,202,944	32,895	81,896**	.....	1,393,256	1,077,647	313,525
National†	.....	.....	.....	.....	.....	.....	.....
Northwest	1,390,120	467,115	298,052**	.....	2,238,697	2,064,563	174,134
Pan American							
Alaska	292,000	19,000	54,000**	.....	385,000	600,000	−216,000
Atlantic	8,093,000	630,000	694,000**	.....	10,186,000	9,362,000	852,000
Latin America	5,545,000	167,000	962,000**	.....	7,317,000	7,978,000	−676,000
Pacific	4,545,000	481,000	636,000**	.....	6,702,000	6,216,000	478,000
Panagra	1,280,000	37,000	.....	126,000	1,719,000	1,667,000	52,000
Trans World	3,351,743	412,556	374,850**	.....	4,396,650	4,784,108	−227,280
United	837,563	35,432	.....	15,326	894,237	872,221	22,016
LOCAL SERVICE							
Allegheny	391,968	6,273	9,284	7,003	737,577	659,031	78,546
Bonanza	168,497	3,060	1,587	2,905	275,300	274,725	308
Central	106,668	3,349	953	3,284	307,222	340,287	− 33,065
Frontier	262,170	219,334	2,727	19,543	518,513	541,931	− 27,922
Lake Central	121,893	3,510	4,812**	.....	250,086	277,060	− 26,974
Mohawk*	.....	.....	.....	.....	.....	.....	.....
North Central	515,242	16,136	9,191	.....	690,131	782,034	− 94,817
Ozark	289,380	485,326	7,504	7,881	793,805	603,962	182,293
Piedmont	409,789	8,027	3,581	5,395	664,461	682,223	− 7,653
Southern	183,337	8,260	3,424	.....	350,387	367,787	− 17,400
Southwest	316,414	9,745	2,477	3,728	468,584	494,793	− 32,162
Trans-Texas	274,140	9,699	3,103	10,237	548,923	571,165	− 21,314
West Coast	196,860	3,875	1,552	2,797	353,097	365,785	− 12,668
HAWAIIAN							
Hawaiian	382,864	3,580	.....	56,078	478,042	433,738	34,304
Trans-Pacific	166,579	1,101	5,724**	.....	180,507	179,337	1,171
CARGO LINES							
Aerovias Sud-Americana	.....	.....	.....	.....	168,723	162,327	6,396
Flying Tiger	.....	10,210	760,702**	.....	2,428,023	2,600,774	−232,542
Riddle	.....	12,721	506,711**	.....	574,488	679,679	−123,842
Seaboard & Western	.....	.....	.....	.....	2,210,362	1,963,188	242,367
Slick	.....	19,000	22,000	682,000	1,916,823	2,267,987	−351,164
HELICOPTER							
Chicago Helicopter	12,045	71,820	.....	.....	84,350	96,082	− 11,732
Los Angeles Airways*	.....	.....	.....	.....	.....	.....	.....
New York Airways	37,511	3,677	1,148	2,633	155,777	198,996	− 43,996
ALASKAN							
Alaska Airlines	109,363	47,197	952	59,493	440,935	474,397	−33,462
Alaska Coastal	51,511	9,018	.....	7,031	107,810	106,920	891
Cordova	10,210	36,428	.....	5,257	134,180	94,831	39,349
Ellis	40,488	4,438	.....	5,732	78,360	75,013	2,968
Pacific Northern	359,837	52,512	82,848**	.....	736,220	697,814	33,836

* Not available. ** Total property; express, freight, charter and others. † System figure.
Compiled by AVIATION WEEK from reports to the Civil Aeronautics Board.

SHORTLINES

► **United Air Lines** will begin daily nonstop, 86-passenger Douglas DC-7 air coach service between Chicago and Los Angeles on July 11. The new service also will provide additional nonstop service between New York and Chicago. Flights will leave New York at 10:30 a. m., and are scheduled to arrive in Chicago at 12:28 p. m. CDT and Los Angeles at 5:25 p. m. PDT. The eastbound flight will leave Los Angeles at 11:35 a. m. with scheduled arrivals at Chicago at 7:15 p. m. and New York at 11:37 p. m.

► **British Overseas Airways Corp.** will introduce the Bristol Britannia turboprop transport on the carrier's London-Tokyo route on July 16. BOAC says the aircraft will cut the time to approximately 41 hours on eastbound flights and 44 hours on westbound flights. BOAC has been using Lockheed Constellations and Argonauts on the route. Constellation's London-Tokyo schedule is 47 hours eastbound, 50 hours westbound. The Argonaut's schedule calls for 72 and 60 hours respectively.

► **Real-Aerovias** of Brazil has increased its order from three to four Lockheed 1049H Super Constellations at a cost of approximately $10 million. The four aircraft will be used on the airline's Chicago-Miami-Buenos Aires route on a six roundtrips weekly basis. Delivery will begin in December and continue through March.

► **Sabena Belgian World Airlines** carried the 100,000th passenger on its international helicopter service on June 15. The passenger was Belgian Ambassador to Germany Baron Herve de Gruben.

► **Seattle-Tacoma International Airport** handled a total of 119,735 passengers in May as compared with 107,708 during May last year. Airmail totaled 1,849,650 lb. in comparison with 1,536,036 lb. last year. Air freight dropped from 3,127,212 lb. in May, 1956, to 3,095,919 lb. Air express fell from 226,175 lb. to 191,290 and first-class mail was down from 193,682 lb. to 163,992 lb.

► **Western Air Lines** will begin daily nonstop Douglas DC-6B service between Los Angeles and Mexico City on July 15. The new flights will be staffed with pilots and stewardesses trained for bilingual operation. Western is completing a reservations and sales center in Mexico City under the direction of Western technicians.

AIRLINE OBSERVER

► Planned inauguration of three Bristol Britannia turboprop transports on Northeast Airlines New York-Florida route will be delayed beyond the early fall target date because of Civil Aeronautics Board refusal to grant the airline a 90-day waiver on landing gear "pivoting" requirements. Last week the Board ruled that Northeast must comply with type certificate provisions requiring aircraft to "pivot about on one side of the main gear, the brakes on that side being locked" before the Britannias are placed in to service. Bristol has said the substantial modifications necessary to fully meet the pivot load requirements will delay certification of the Britannia on Northeast's route beyond the "coming winter season." Northeast asked for the 90-day waiver in order to get the first three of five Britannias on order in service as originally planned.

► **Air Line Pilots Assn. and the International Assn. of Machinists have signed a jurisdictional and mutual assistance pact as part of a cooperative program "to raise wages and improve working conditions for airline employes." The agreement provides for close coordination in settling any disputes between the two unions and calls for mutual assistance in disputes between the air carriers and either one of the unions. The two organizations represent approximately 50,000 of the estimated 122,000 persons now employed by the scheduled airlines.**

► Civil Aeronautics Board hearings on a possible control case involving Atlas Corp., Northeast Airlines, Trans World Airlines and Howard Hughes will be held in New York on July 8. A CAB investigation is being held to determine whether acquisition of an interest in the Atlas Corp., which controls Northeast Airlines, by Howard Hughes, sole owner of the Hughes Tool Co. which controls TWA, is a transaction requiring CAB approval of common control of carriers.

► **American Airlines President C. R. Smith has proposed to the Civil Aeronautics Board a reduction of the family fare discount by 50% and the elimination of roundtrip, circle and open-jaw discounts, free stopovers and excessively circuitous routings. Smith called the proposed 6% fare increase insufficient but said American will file tariffs providing for such an increase if the raise is approved by the Board.**

► CSA, Czechoslovakia national airline, has taken delivery on the first of five twin-engine Avia 14 transports it has on order. Avia 14 is a Czech-built version of the Soviet Ilyushin 14 and is built under Russian license by Avia at Letnany near Prague. The five Avia 14s are the first transport aircraft built in Czechoslovakia since World War II.

► **American Airlines' motion for an immediate decision in the Capital Airlines Family Plan Case has been dismissed by the Civil Aeronautics Board. Last month, the Board announced that it would defer a decision on Capital's request for an extension of the family plan to include Saturdays until a general investigation of family fares was completed.**

► Col. Bernt Balchen, USAF (ret.), a veteran Arctic pilot and explorer, has joined Resort Airlines as a vice president.

► **Civil Aeronautics Administration will begin operation of the Los Angeles-Pueblo airways via the Grand Canyon on July 4. The new airway, Victor Airway 210, is based on VORs installed at Los Angeles; Daggett, California; Valle, Arizona; Farmington, New Mexico; and Pueblo, Colorado where it ties in with Victor 10 running from Pueblo to New York City.**

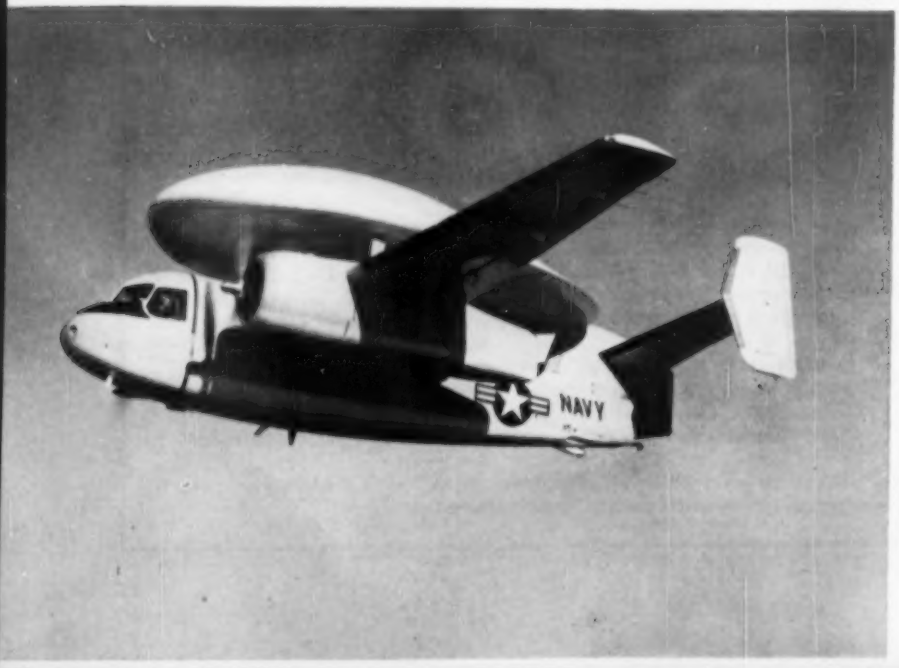
► Pakistan International Airlines has purchased two 1049H convertible cargo-passenger transports from Lockheed Aircraft Corp. with delivery scheduled early next year. Planes will start service in 92-passenger configuration with a possibility of later increasing capacity to 114 seats through six abreast seating.

► **Australian government has vetoed Australian National Airways proposal to merge all airlines into a single government corporation.**

FIRST OF A FAMILY, Grumman S2F began as design for Navy antisubmarine airplane.

FIRST ADAPTATION of the design, TF-1 cargo/transport, has larger internal volume.

EARLY WARNING WF-2 below, based on TF-1, took only year from drawing board to flight.



S2F Design

By Russell Hawkes

New York—Variations of the Grumman S2F carrier-based submarine hunter-killer are being made to play an increasing number of roles in Navy's operational planning. Variations include the WF-2 early warning radar picket and the TF-1 utility transport. Other developments are well advanced.

Adaptation of an existing design to new uses is a well established practice in the Navy. Advantages it offers are:

- **New airplanes** with minimum strain on the budget.
- **Parts interchangability** between airplanes having different missions, reducing the number of spares which must be stocked aboard ship.
- **Maximum utilization** of maintenance and air crews. Reduction in the number of specialized and untransferable support organizations built around single designs reduces manpower requirements.

The S2F offered unusual opportunities for redesign. Grumman officials assert that the anti-submarine mission for which it was designed is one of several which do not require a high performance airplane and economy advantages favor the use of one basic airplane for as many non-high-performance missions as possible. Because performance requirements are low, the rate of obsolescence due to technical advances in airframe and engine design is slower and there is less chance new designs would be superior enough to justify their much higher cost.

Operational Flexibility

Defensive and supporting chores which can be handled by a low performance family of airplanes are vital to the use of the offensive weapons which are the main striking arm of the carrier task force. Because all of its members can operate from slow, inexpensive escort carriers the S2F-TF-WF family has considerable flexibility of employment.

Basic S2F antisubmarine plane equipped with MAD, sonobuoys, radar, homing torpedoes and depth charges has been in service since 1953 and is now being produced at the rate of seven per month. About 560 have been built. There is no reason to suppose that the S2F will soon be replaced as the standard carrier-borne antisubmarine weapon. Present submarine defense could not cope with a Russian attack but the inability is caused not by the limita-

Sires Family of Economical Adaptations

tions of the airplanes but by the limited range of present submarine detection gear. There is reason to expect great improvement in this respect in the near future.

First of the S2F adaptations was the TF-1 carrier-based utility transport having a deeper wider fuselage. Because of its larger internal volume, the TF-1 was the basis upon which the saucer-radomed WF-2 was designed and will probably be the basis for any further evolution. The TF-1 was conceived originally as an operational trainer for S2F pilots, but fleet experience with the ASW plane showed that there was less need than expected for a trainer version.

Quick Change

The TF-1 can be field changed in about an hour to any one of four interior configurations: general cargo, "special cargo," personnel or ambulance. The cargo versions have a part in the airborne carrier resupply idea which is being proposed increasingly to the Navy. The purpose of the aerial resupply plan is to extend the time which a carrier can operate away from its surface logistics organization. Combat time without surface resupply is now limited to 3-5 days. Bringing in small off-the-shelf items would make available more space aboard ship for items which are not air transportable. Air supply of seldom used items makes it possible to spread these thinner in the fleet while keeping a flexible centrally located reserve. Another obvious advantage is that air supply lines are less vulnerable to enemy interdiction.

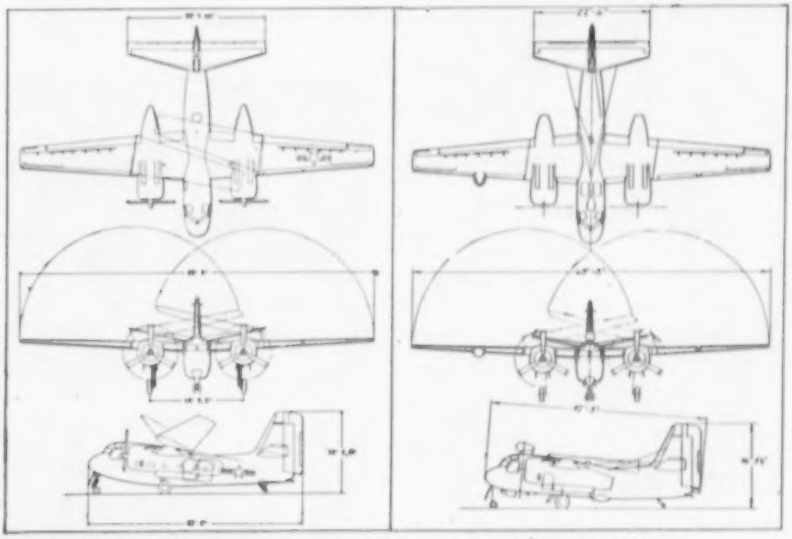
The TF-1 carries 3,500 lb. of cargo and operates off CVEs at its maximum gross weight. It makes unassisted take-offs from Essex class carriers with only 2 kt. of wind over the deck. This would indicate that under most circumstances an attack carrier could launch and recover TFs without changing course if an enemy threat made this necessary.

Maximum permissible floor loading is 220 lb. sq. ft. The floor is high strength metal honeycomb and is not damaged by the use of wheeled dollies without protective mats. The floor and cargo restraints are stressed for 20 G crash loads and can withstand arrested landings and catapult shots.

The cabin entrance is a two piece door. The passenger section is opened and closed by the usual knob and latch. The cargo door is an integral part of the fuselage structure and is held in place by six bolts. It can be removed in about 15 minutes to open a 50 in. x 67 in. doorway. The door sill is 24 in. above the deck.

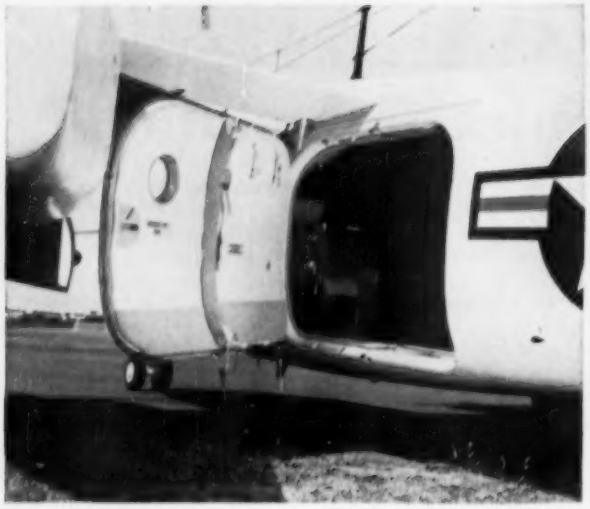
Cargo is restrained by a rigid cage which Grumman engineers judged superior to the more common barrier web for carrier transports. The extruded dural I-beam and built-up box-beam cage members can be assembled to fit the cargo. The members are secured by quick disconnect pins which do not require the use of tools for assembly or disassembly. The main longitudinal members are permanent flush tracks in the floor and removable I-beams close to the ceiling. The horizontal webs of the upper rails are perforated to receive the upper ends of box section verticals. The lower ends of the verticals are secured to fittings spaced at 2 in. intervals in the floor rails.

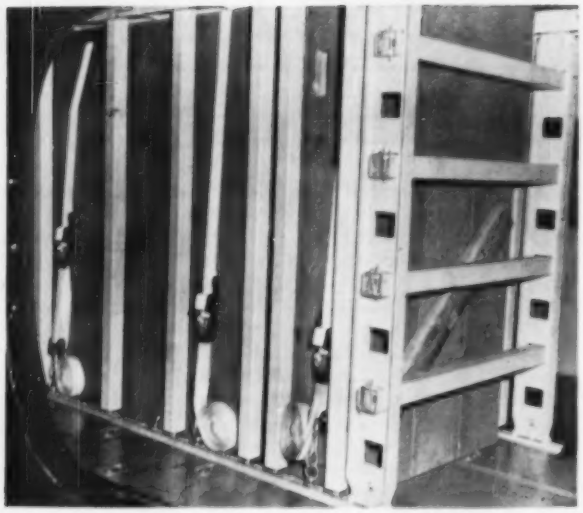
Four heavy I-beam stanchions form the vertical corners of the cage. The



THREE VIEWS of TF-1 (left) and S2F-1 shows variation in fuselage, stabilizer.

CABIN INTERIOR, looking forward in TF-1, has four port, five starboard aft facing seats.





CABIN ENTRANCE of TF-1 is two piece door 50 in. x 67 in. (left). Cargo cage (right) is adjustable, leaves narrow cabin passage.

forward stanchions can be installed at only one station and are much heavier since they are expected to bear heavier loads. The aft stanchions can be installed in the floor track fittings in positions at 4½ in. intervals.

Transversal box section members are secured between the stanchions by quick disconnect pins. Assembled cage is 31 in. wide, 51 in. high and its length is adjustable to the size of the cargo. Maximum length is 109 in. The installed cargo cage leaves a narrow passageway along one side to give the crew access to any part of the cabin including the toilet aft. In carrier suitability trials, a 3500 lb. rectangular crate measuring 27 in. x 46 in. x 92 in. was successfully loaded and unloaded.

Nuclear Dispersion

Widely dispersed task force elements made necessary by nuclear tactics call for an inter-ship taxi with more range and speed than vehicles used in the past. The TF-1 passenger version fills this need and is the logical successor of the TBM and AD-5 variations which have been pressed into that service.

When the interior is converted from the general cargo to the personnel configuration, the cage members are stored in the toilet and the engine nacelles. Each nacelle also contains a seven man life raft which can be launched and inflated from the cockpit or from the side of the nacelle.

Nacelles of the S2F design had to be lengthened to provide the necessary storage space.

Nine reclining aft facing passenger seats with shoulder harness are folded against the sidewalls in the cargo configuration. When installed and secured to the floor tracks, these are stressed for 20 G. Removable upholstery and rugs complete the conversion. Cabin and cockpit are insulated thermally and acoustically. The nine seats are arranged with five on the starboard side and four on the port side.

Ambulance planes shuttling between unprepared front line strips and carriers far at sea proved their worth in Korea.

In the ambulance configuation of the TF-1, three seats are removed and three litters are installed on the starboard side, one above the other. Either Stokes litters, canvas-and-pole, or evacuation cots may be used. Two support posts are the only additional equipment needed. The remaining six seats may be used by walking patients or medical attendants.

Patients may be secured to the litters for catapult launchings and arrested landings. However, the ability of the TF to make unassisted deck takeoffs should make it unnecessary to use the catapult.

Escape provisions include overhead ditching hatches at each end of the cabin and an emergency release to jettison the passenger door in flight. The crew can escape through two transparent sliding hatches over the pilots' heads.

Heating System

A thermostatically controlled combustion heating system is capable of keeping cabin temperature at 65F when outside air temperature is zero.

Lead time in converting the S2F to the TF was only 2¼ years despite the small scale of the effort applied. There are now 45 of the transports in service. The latest order has a total value of $24 million and will go into production in November at a rate of three per month.

The TF has complete all-weather instrumentation and full span inflatable de-icing boots on the wing and tail surface leading edges. Propeller de-icing is electric and the windshield is de-iced by a fluid spray.

Curved spoilers are used for lateral control with vestigial ailerons to provide aerodynamic feel. Electrical stick shaker stall warning is installed.

Wings are folded by a 3,000 psi. hydraulic system in less than 42 sec. in a 45 kt. wind blowing from within 45 deg. of the nose. They fold at reduced speed with one engine inoperative. Landing gear and flaps are extended and retracted by a 1,500 psi hydraulic system. They may be operated by a hand pump drawing on an emergency reservoir if the main system fails.

Maintenance Record

The TF has a good maintenance record. In acceptance trials it averaged less than three maintenance man hours per flight hour for over 300 hours of operation.

Latest variation of the basic design is the WF-2 early warning aircraft. The big overhead radome, largest ever mounted on a carrier plane, enables two operators in the cabin to detect enemy aircraft at great distances. The radius of action of the airplane plus the range of the radar provides ample time to launch defending fighters. A fighter director station occupied by one of the pilots makes it possible for the tactical air control team in the WF to vector friendly fighters toward the attacking aircraft. The radar can also detect enemy surface forces.

The WF-2 progressed from drawing board to first flight in less than a year. Six months of this time was occupied in the actual modification of an existing TF-1 airframe. The redesign necessitated a difficult compromise between electronic and aerodynamic requirements.

The radome installation demanded a

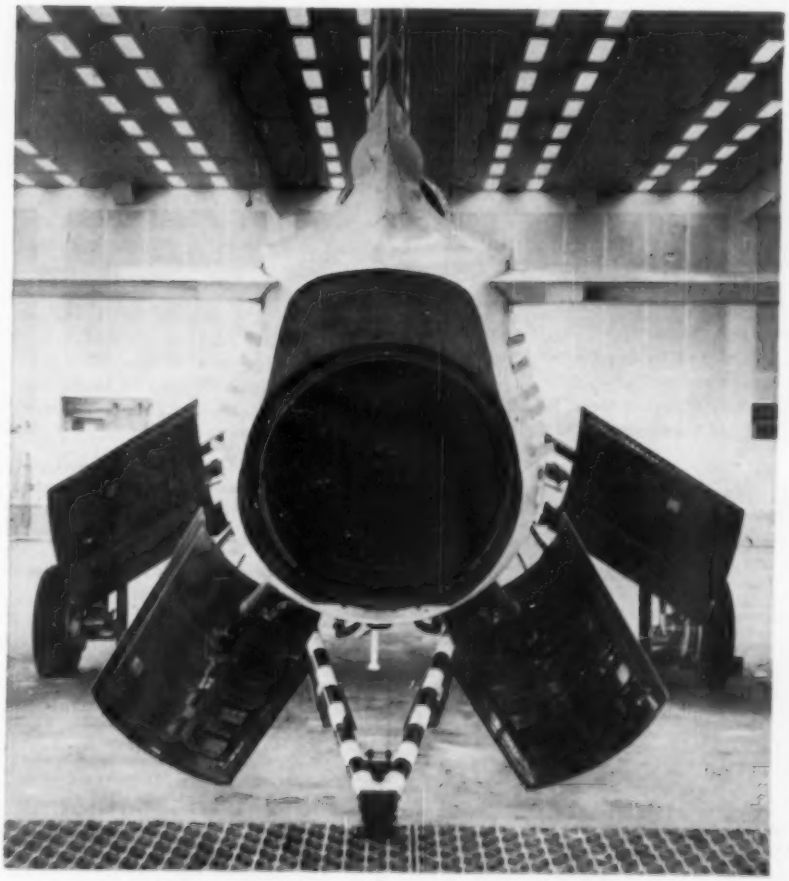
complete redesign of the empennage to put vertical tail surfaces outboard of the radome wake. The aft fuselage section was stretched to get a longer moment arm for the tail surfaces to operate on. This move was probably dictated by the effect on stability of the radome and possibly by the effect of the weight of the heavy radar gear inside the fuselage.

Fuselage nose section was stretched 18 in. forward to keep the CG within limits. To cope with higher moments of inertia when the nosewheel is slammed onto the deck, the nosewheel structure was strengthened. An oleopneumatic shock absorber with longer stroke than that of the TF is being designed.

The overhead wing fold geometry of the S2F and the TF had to be abandoned because of the location of the radome. The aft folding design of the WF-2 is reminiscent of the Grumman-designed TBF-TBM and the AF single-engine anti-sub plane. Two hinges aft and two locks forward at the wing fold line make a four-point structural attachment in the spread position. In the folded position, the hinges support the weight of the outboard panels. A single 1,500 psi. hydraulic cylinder swings each panel down and aft.

Tail wheel had to be redesigned to caster freely while taxiing as the aft shift of the center of gravity when the wings are folded makes it a tail-wheel airplane. The main landing gear is essentially the same as that of the TF. The middle 60 in. of the wing center section was modified to provide more fuel capacity to return the range of the heavier, dirtier airplane to that of the TF.

The large structural cargo door is eliminated to save weight. The radome will be made of Fibreglas honeycomb sandwich.



Speed Brakes Added to FJ-4B

Second set of speed brakes (lower pair) are the major external change in the North American FJ-4B, which recently completed its fleet introduction program. Brakes, here fully extended, are linked, but a bungee on rear, or lower set, causes lower set to close automatically when landing gear is lowered. Produced by North American's Columbus plant, FJ-4B is designed for low altitude attack. It grosses more than 26,000 lb., has service ceiling of more than 45,000 ft. Powerplant is Curtiss-Wright J65-16A turbojet developing 7,800 lb. thrust.

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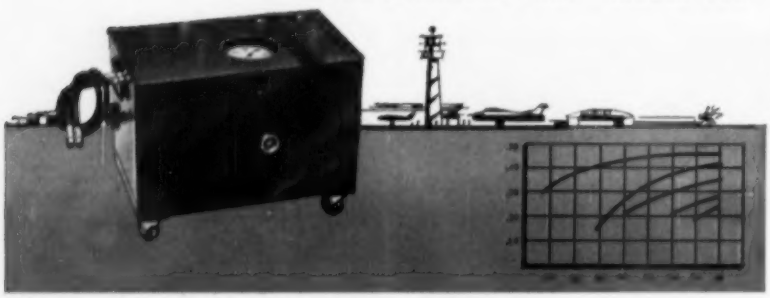
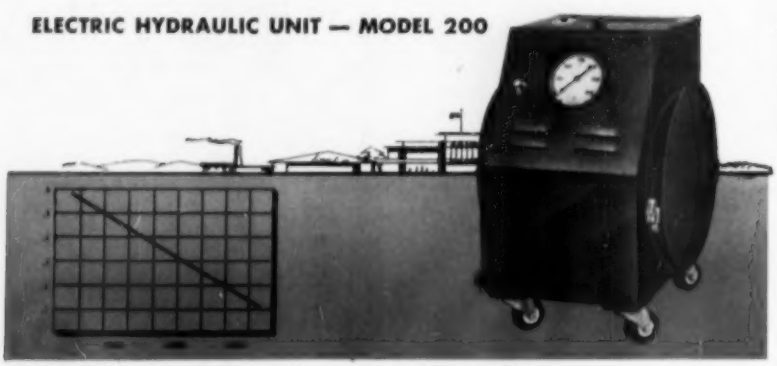
AIR HYDRAULIC UNIT — MODEL 100



This unit is explosion proof and features a demand system with constant pressure to 3000 psi. Pressure is accurately adjustable to 25 psi, the system is filtered and is powered by a piston-type, air-hydraulic booster pump incorporating an automatically operated air selector valve. All parts are commercially available.

SPECIFICATIONS:
Dimensions—19⅓" x 11¾" x 14" high.
Weight—75 pounds.
¼" pressure and return hoses, ⅜" air supply hose and 1 gallon reservoir.

ELECTRIC HYDRAULIC UNIT — MODEL 200



This 110V ac or dc unit features a demand system with constant pressure to 3000 psi. Pressure is accurately adjustable to 25 psi, the system is filtered and is powered by a high-speed, high efficiency gear pump. All parts are commercially available.

SPECIFICATIONS:
Dimensions—16¼" x 14¼" x 23" high.
Weight—85 pounds.
¼" pressure and return hoses, 110V ac or dc power, 1 gallon reservoir and ½ hp, 115V motor.

Both of these units may be modified to conform to customer specifications.

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WRITE FOR COMPLETE DATA

Nuclear Batteries Studied by ARDC

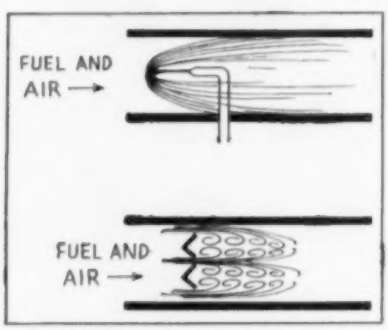
Los Angeles—Wright Air Development Center is studying development of lightweight nuclear batteries for use as secondary power sources in space aircraft.

The need for such a battery, or similar lightweight, self-contained secondary power sources for instruments and other components, was recently outlined by Lt. Gen. Thomas S. Power, commander of the Air Research and Development Command, at the national summer meeting of the Institute of the Aeronautical Sciences. Another possibility under study, Gen. Power said, is a practical means for converting solar into electrical energy.

Projects outlined by Gen. Power in USAF's research and development effort into space technology include:

• **Solar radiation.** To broaden the "limited knowledge" on solar radiation, the predominant force behind physical and chemical events in the atmosphere, Air Force Office of Scientific Research and the Cambridge Research Center have awarded study contracts to several universities. ARDC's Upper Air Observatory on Sacramento Peak, N. M., is attempting to determine the effect of solar disturbances on the atmosphere and radio communications.

• **Nature and variations** of cosmic radiation are being studied for USAF at the Universities of Chicago and Maryland. Investigations of the biological effects of cosmic radiation at Holloman Air Development Center have included tests with animals carried aloft by high-



Fluid Flameholder

Aerodynamic flameholder developed by Stanford Research Institute, Menlo Park, Calif., to cut down drag in afterburners. Advantage of this arrangement is that the air jet nozzles (top) has less drag in the non-afterburning condition than the v-shaped flameholders (bottom). One per cent bleed from the turbojet engine compressor supplies the air for the jet. Northwestern and Cornell universities are studying similar problems.

British Fly Gas Turbine Helicopter

Prototype for British Westland Wessex helicopter makes its first flight powered by Napier Gazelle free-turbine engine. Wessex, a Sikorsky S-58 built under license, is first British helicopter to fly on turbine power.

altitude balloons for as long as 35 hours.

• **Improved weather forecasting** techniques.

• **Number and mass of meteorites.** Detailed information in this area, Gen. Power said, is important "not only for the design of missiles and vehicles exposed to them but also because of their effect on the ionosphere and radio communications."

Bristol Helicopter Details Revealed

London—Recently released details of Bristol Aircraft's Type 192 helicopter powered by two Napier gas turbine engines reveal that the helicopter, capable of carrying from 18 to 25 troops and now in production for the Royal Air Force, has a cruising speed of 120 kt. at a gross weight of 18,000 lb.

The two Napier Gazelle Series 2 engines provide a power output limited to 920 shp. in twin-engine operation. Maximum continuous power is 1,050 shp. with a one hour power of 1,300 shp. Emergency power is given at 1,650 shp.

A synchronizing shaft interconnecting the two engines provides single-engine safety by keeping the rotors in proper phase relationship and permitting both rotors to be driven by one engine in an emergency.

Bristol reports that power characteristics of the turbines permit the helicopter to cruise at its maximum speed of 120 kt.

Without rotors, overall length is about 54 ft., height 17 ft., and width 18 ft. 9 in. The helicopter's main cabin

M1238-1818 — *Range 18" x 18", working distance 9" to infinity. Reads to 0.001" up to 24" working distance. Protractor ocular reads to 3 minutes of arc. Image is erect.*

Cut inspection time in half

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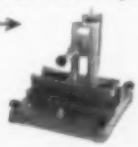
These convenient, reliable optical instruments permit making precise coordinate measurements in a vertical plane. The two dimensions are measured with one setting, object does not have to be rotated. Inspection time is cut in half and resetting errors eliminated.

Versatile Gaertner Coordinate Cathetometers are ideally suited for precision measurements on large objects; also objects or points in recessed, remote, or inaccessible locations. Applications include measuring jet engine sections, complicated castings, printed circuits, bolt holes and bosses on large piece parts, traces on cathode ray tubes, etc.

Because these are optical rather than mechanical measuring instruments, you make non-destructive measurements without contact, distortion, or concern about pressure being applied to the object when making a setting. Instruments available in English or Metric system.

M1236-46— Horizontal range 6", vertical range 4", Reads to 0.0001", working distance 5" to infinity.



M1236-22— Range 2" x 2", reads to 0.0001". Working distance 5" to infinity. Shown with 19 mm mounting rod, and without telemicroscope. Instrument permits precise coordinate movement of other objects such as photo cells, probes, etc., in place of telemicroscope.

Write for Bulletin 188-53

The Gaertner Scientific Corporation

1201 Wrightwood Ave., Chicago 14, Ill.
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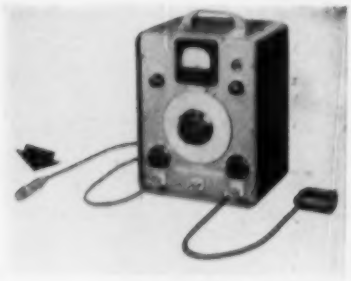

Kistler Indicator Measures Engine Pressure Changes Quickly and Precisely

Featuring high sensitivity and extremely fast response, the new precision-made Kistler SLM Engine Pressure Indicator has been designed for research, engineering, testing and evaluating diesel, gasoline, gas, jet, rocket and atomic engines. It is rapidly being adopted by the automotive, aircraft, engine and fuel industries.

Pressure changes generating an electrical charge in the Swiss-made SLM Pressure Pickup are measured by an electrostatic type amplifier and displayed on an oscilloscope. Small pressure variations in overall cylinder diagrams can be magnified as much as a thousand times. Rugged enough to withstand diesel combustion and other temperatures up to 600° F, without special air or water cooling, the pickup will measure combustion pressures for all ranges, 0.1 through 3000 psi. With the addition of a Kistler adaptor, fuel injection pressures to 20,000 psi can be measured.

The ability of the SLM Indicator to measure directly either *pressure* or *rate* of pressure changes, makes it invaluable for fuel, combustion and detonation studies, load balancing, monitoring, peak pressure adjustment on production engines, and maintenance or repair operations. The most advanced engine analyzer available, it can be operated as readily as a TV set. Trouble shooting and ignition or injection timing are greatly simplified. Optional equipment includes a selector switch which permits operation of several pressure pickups with a single amplifier-calibrator unit, and a piston displacement indicator for direct display of traditional indicator diagrams.

For complete information on the SLM Pressure Indicator, including Swiss-made SLM Pickup, special low-noise cables and the Kistler "Piezo-Calibrator" (amplifier-calibrator), request Bulletin EPI-114.

Kistler Instrument Corp., Dept. AW, 15 Webster St., North Tonawanda, N. Y.

First Sycamores for Germany

These two British Sycamores have left Bristol Aircraft's factory and are bound for Western Germany. Helicopters, the first deliveries of an order of 50, have German markings, including the warning "Achtung" on tail rotor.

length is 24 ft., height is 4 ft. 11 in., and width is 5 ft. 3 in. The twin four-bladed rotors have a diameter of 48 ft. 8 in. Maximum design rotor rpm. is 270 and maximum design rotational tip speed 687 ft./sec. Fuel capacity is 672 U.S. gal.

Performance figures at 18,000 lb. include a service ceiling of 13,250 ft., hovering ceiling without ground effect of 8,000 ft., a vertical rate of climb on two engines of 500 ft./min. and an optimum rate of climb with forward speed of 1,175 ft./min. Optimum rate of climb on single engine with emergency power is 760 ft./min.

Type 192 can carry 23 armed troops at 250 lb. each for a still air range of 130 nautical miles. Range of 390 nautical miles is provided for 12 stretcher cases and 3 sitting wounded. Alternatively, 6,000 lb. of freight can be carried over 125 nautical miles.

In search and rescue operation, provision is made for rescue of 10 persons from the sea within a radius of 200 nautical miles, with fuel for 20 min. of hovering during rescue and reserve fuel amounting to 28% of the initial fuel load.

Extra tanks installed in the fuselage for ferrying can increase the still air range to 620 nautical miles. Nineteen paratroops can be carried 115 miles.

Bristol says the 192 is fully equipped for day and night instrument flying, with additional provision for automatic pilot and dual controls.

It is equipped with a spring-balanced door which can be opened and closed in flight. A winch capable of hoisting loads up to 600 lb. attached to the underside of the upward-swinging door can be operated either by the pilot or a crew member.

Loads up to 5,250 lb. which cannot be carried in the cabin can be slung from a strong point beneath the fuselage.

International Air Group Is Founded

First world wide organization with the specific purpose of extending international scientific collaboration in all areas pertaining to flight was formed May 30 in Paris by 10 nations. Known as the International Council of the

X-2 Altitude Confirmed

Los Angeles—Nine months after its happening, Gen. Thomas S. Power, commander of the Air Research and Development Command, has been permitted to confirm the height reached last September by Capt. Iven Kincheloe in the Bell X-2 for a new altitude record.

Confirming an Aviation Week report last Sept. 20 (p. 29), Gen. Power told the National Summer Meeting of the Institute of the Aeronautical Sciences:

"Last year, Capt. Iven Kincheloe of ARDC's Air Force Flight Test Center flew the Bell X-2 rocket-powered test vehicle to an altitude which I can now confirm to have reached 126,200 ft."

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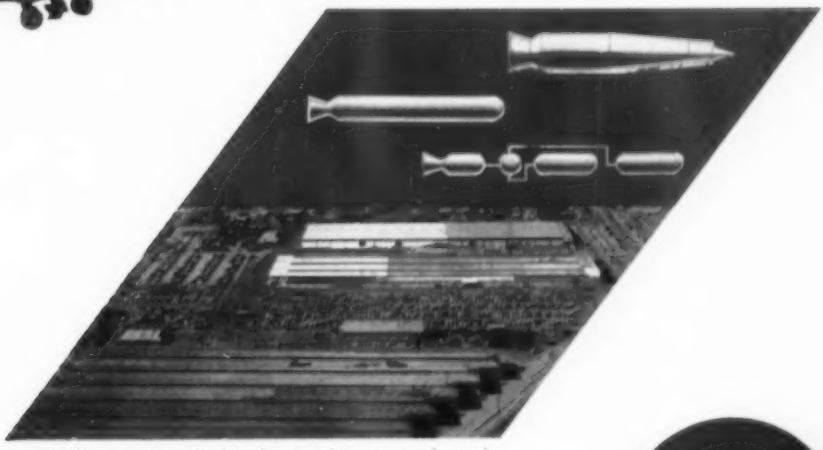

View of Rheem Downey facility showing the area now devoted to jet engine production

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Behind a 36-inch-thick radiation-resistant window deep within the first laboratory of its kind in the industry, Goodyear scientists are unlocking a whole new field of rubber research—studying the radioactive effects of powerful

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There, on an elevator under a water shield, rest 648 tiny slugs of powerful, radioactive Cobalt 60.

Each "slug" is but an inch long and one-eighth inch in diameter—yet direct exposure to this Goodyear Cobalt 60 could, in a few sweeps of a second hand, fatally contaminate a man.

Present-day rubber is also vulnerable.

COBALT 60 is there as part of an extensive pioneering study which is destined to unlock the vast secrets in a whole new field of rubber research.

From it may come the first rubber which can resist atomic radiation, new tires for trucks and cars which can run cooler, radiation-cured rubber which will outperform any now known, as well as food pasteurized through radiation, new "synthetic rubbers," and a host of new products yet undiscovered.

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Goodyear, Aviation Products Division
Akron 16, Ohio, and Los Angeles 54, California

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Seven New Birds

While describing the various types of managers found in industry today at the summer IAS meeting, Dr. Myles L. Mace of Litton Industries noted that the Audubon Society recently designated seven new types of birds, labeling them Delegatos Americanum. The birds, and their counterparts:

- The White-Shirted Hoverer (watches every move his people make).
- The Pin-Striped Whoopster (sharp politico talker type).
- The Baldheaded Perforator (shoots holes in everyone else's ideas).
- The Pussy-Footed Mouse trapper (always waiting to catch others in mistakes).
- The Grey-Thatched String Holder (no one allowed to progress if he can help it).
- The Yellow-Bellied Credit Snatcher (sees to it that boss always gets impression that if it was good, he did it).
- The Lesser White-Crested Cockatoo (the fair haired prince who, by habit, lays the egg in the other fellow's nest).

Aeronautical Sciences, the group will hold its first congress in Madrid during September, 1958.

Plans for the organizational meeting in Paris were completed during the annual meeting of the Institute of the Aeronautical Sciences in New York early this year. The new international society has resulted from a strong feeling here and abroad that such a group was needed to improve liaison between the world's aeronautical scientists. Until recently the formation of such a society has been hampered for lack of funds. The Guggenheim family has stepped in to fill this need.

Membership is open to any country with an organized scientific aeronautical society, without regard to military or political interest.

The United States is represented by the IAS.

No Communist countries are among the founding nations though it is hoped that every nation will seek membership, broadening international scientific cooperation for the benefit of aeronautics.

Prof. Theodore von Karman was elected honorary president and permanent member of the governing council of the ICAS. Maurice Roy of France was elected chairman of the provisional council's executive committee.

Polaris Launching Contract Awarded

Westinghouse Electric Corporation will design and manufacture experimental seagoing handling and launching

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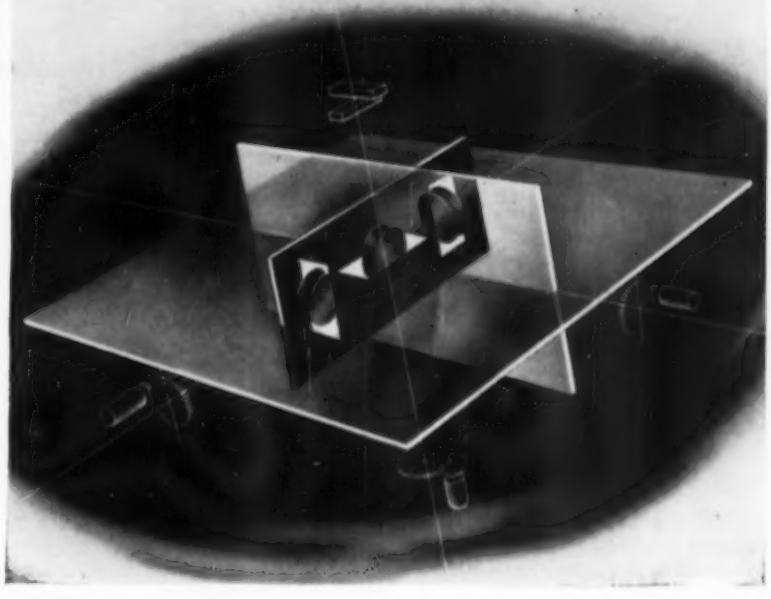

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Long Stack Aids HOK Stability

Exhaust stack lengthened to carry gasses from Lycoming T53 engine clear of rotor disk improved longitudinal cyclic control and eliminated exhaust induced rotor vibration in Kaman HOK helicopter. Stack was bifurcated to carry gasses past each side of center stabilizer. Comparison tests were carried out with short stack, and gasses directed upward through aft edge of rotor disk produced nose up trim moment sufficient to compromise forward cyclic control, and they induced rotor vibration. Kaman will make further tests to develop stack to pass jet thrust precisely through center of lift of the helicopter.

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systems for Polaris, leading ultimately to a submarine launching system for the Navy intermediate range ballistic missile.

Contract is with the Bureau of Ordnance.

The Westinghouse activity will be centered at its Sunnyvale, Calif., division facilities.

Polaris, which will have a 1,500-mi. range, is being designed to fire from surface ships as well as submarines. The contract calls for development of various mechanical and electrical systems for the launching of Polaris from either type vessel.

Production Begins of Lithium Oxidants

Two new oxidants for use in high energy fuel systems, lithium perchlorate and lithium nitrate, have been placed in production by American Potash & Chemical Corporation. The two chemicals will be used in solid propellant loads.

Lithium compounds are attractive for propellant use because they have a high oxygen content on a weight basis. Lithium perchlorate has about 60% oxygen and lithium nitrate nearly 70%.

Ryan Acquires Plant At Torrance Airport

Ryan Aeronautical Co., San Diego, acquired an assembly plant and 27-acre industrial site adjacent to the Torrance Municipal Airport. Facilities contain 137,000 sq. ft. of floor space formerly occupied by National Electric Products Corp.

Torrance plant will be used primarily for assembly operations on such major projects at the Douglas DC-8 jet airliner power packages and pylons, and the Ryan Firebee jet drone on which the production rate for the military is being rapidly expanded.

All engineering and fabrication work on these and future projects assembled in the Los Angeles area plant will be performed in San Diego. Torrance facility, combined with new factory facilities nearing completion at Ryan's San Diego plant, will boost the company's total area under roof to 1,285,000 sq. ft.

Under construction at Ryan San Diego site are an Engineering Research and Development Center and a Tooling Fabrication building.

Setting up of equipment for the Firebee assembly line is expected to get under way soon at the Torrance plant, with the DC-8 project to follow in a few months.

FACTS

about

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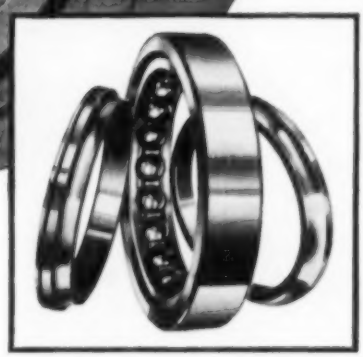

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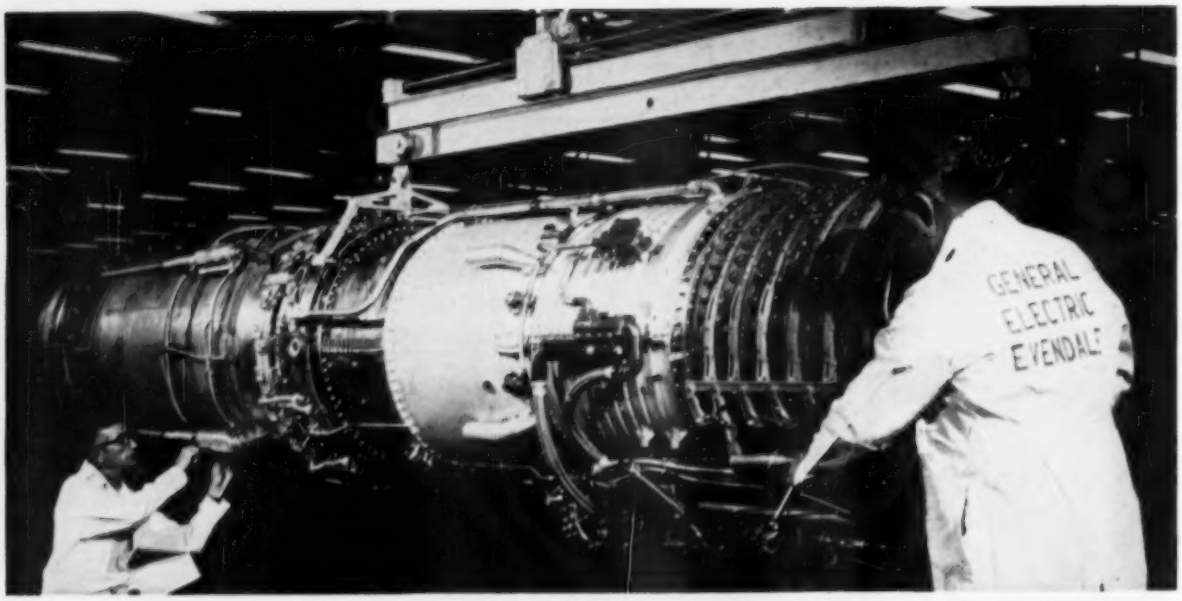

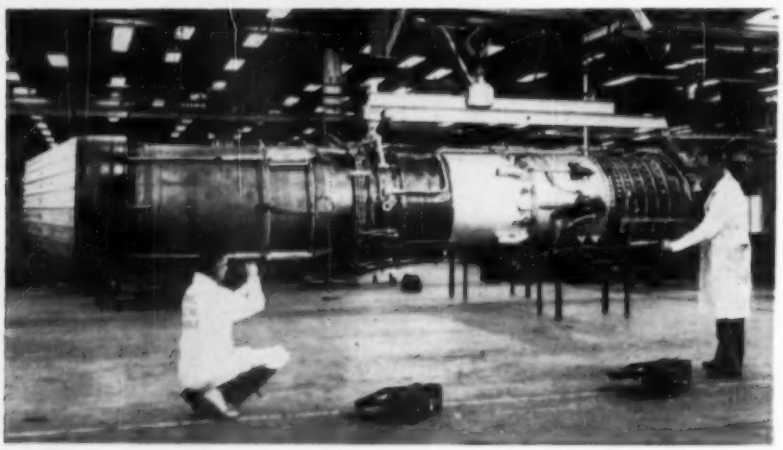

J79 Utilizes Nozzle Vanes, Variable Stators

General Electric's Mach 2 turbojet, the J79, is shown during a factory check (top). The engine delivers considerably more than 15,000 lb. of thrust with afterburner, or more than 50,000 hp. at Mach 2, from a total engine weight of less than 3,200 lb. Guide vanes for taking external air into the afterburner are visible above the head of the kneeling technician. The air could be used for cooling and/or as an aerodynamic means of varying the nozzle geometry which is necessary at supersonic speeds. Typical section of the J79's variable stator control linkage is shown being adjusted (bottom). One of the several power cylinders for linkage is at the top of the picture. How afterburner nozzle closes down for low speed operation is shown (center).

Civil Conway Rated At 16,500 Lb. Thrust

London—Takeoff thrust of the Rolls-Royce civil Conway bypass turbojet engine is rated 16,500 lb.

The R. Co. 10 engine is more than 132-in. long and 42 inches in diameter. It has been ordered for installation on 63 airliners, including Boeing 707s, Douglas DC-8s, and Vickers VC. 10s. Military version is specified for the Handley Page Mark II Victor bomber.

PRODUCTION BRIEFING

Convair started installation of a 75-ton Cyril Bath stretch press for 880 jet transport fuselage belt frame fabrication. Unit will arrive at Convair in September, will start production work as soon as proof tests are completed. Press is 75 ft. long, 30 ft. wide, 12 ft. high, has a 150-in. diameter work table with 360 deg. rotation, and is hydraulically operated.

Douglas Aircraft Co. developed a new spares system for its DC-8 customers, foreign and domestic, wherein punched cards and continuous image microfilms of engineering drawings are integrated to shorten spares lead time and help airlines estimate requirements more closely. System is projected to be ready when first DC-8s are ready for customers.

Hydraulic press with side rams for complex forgings with undercuts or back-drafts has been placed in operation by Harvey Aluminum Co., Torrance, Calif. Each of side rams can exert 2,000 tons, main ram applies 4,000 tons. Bed size between positive stops is 70 in. front to back, 90 in. left to right, with daylight capacity ranging from 45 in. to 90 in. Split dies or conventional ones can be used with side rams and main ram.

USAF contract for modification of existing airborne electronic control systems for all-weather fighters has been awarded Hughes Aircraft Co., Culver City. Contract value is $1,071,239.

Lounge sections for 23 Boeing 707 jet transports will be fabricated by AiResearch Aviation Service Co. with first delivery in September of this year. Remainder of the lounges, which are in two configurations, will be delivered by early 1958. The two configurations of four passengers each are two fore and two aft, and four on a crescent-shaped seat. Design, engineering and testing of the sections will be accomplished by AiResearch.

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America's First Supersonic Bomber

The B-58 is built to fly at supersonic speeds at altitudes ranging above 50,000 feet. It is described as a high-performance medium bomber for big missions—a new concept in aircraft design.

The same applies to the equipment packed in its compact structure—vital equipment like the Bendix* liquid oxygen converter system that supplies life-giving oxygen to its three-man crew.

Size and weight must meet rigid specifications—with no compromise in reliability and performance. The liquid oxygen equipment provided by Bendix—pioneer in the development of liquid oxygen systems—combines these essentials, plus the know-how gained in more than a quarter century of experience as a major producer of airborne oxygen equipment for military, commercial, executive and private aircraft.

No matter what your oxygen requirements may be—either airborne or industrial—Bendix is prepared to serve you. Pioneer-Central Division, Bendix Aviation Corporation, Davenport, Iowa. *REG. U.S. PAT. OFF.

INDICATOR—Capacitance Type Liquid Oxygen Quantity Totalizing

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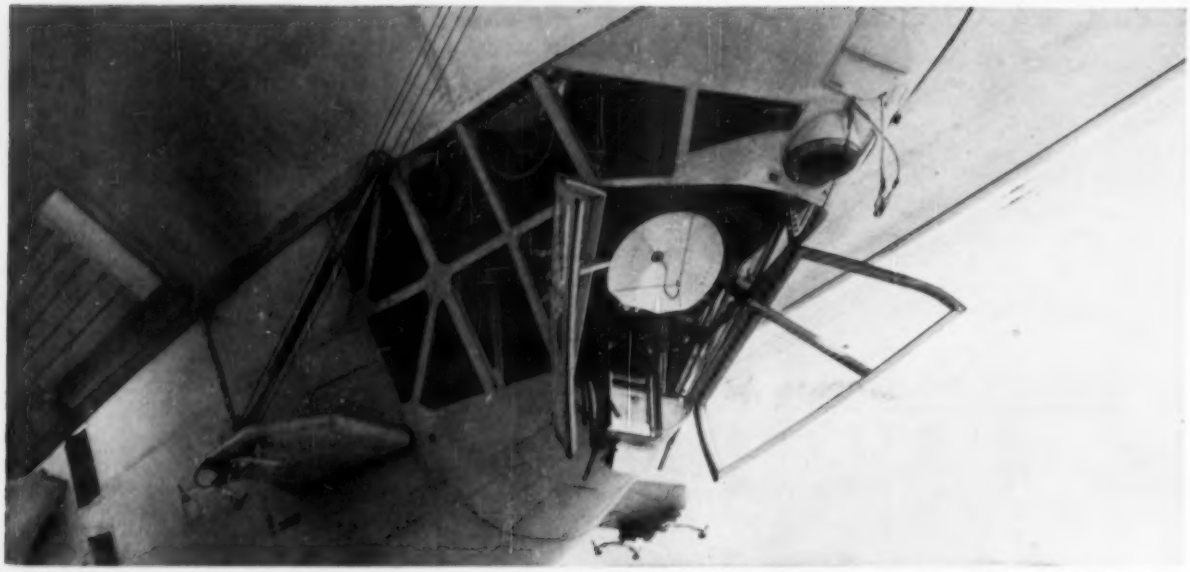


PASSIVE RADAR, promising new detection, surveillance and mapping techniques, underwent early tests on Navy blimp. Parabolic antenna was used for mapping and surveillance. Small slotted antenna underneath was used for guidance tests.

Passive Radar Gives Infrared Technique

By Philip J. Klass

Hanscom Field, Bedford, Mass.— Fundamentally new technique for surveillance, mapping and navigation-guidance which bears some similarity to both infrared and to radar, yet which offers certain advantages over each, has just been revealed. It is called "passive microwave radiometry," or "passive radar" for short.

Like infrared, the new technique detects electromagnetic energy radiated by every object whose temperature is above absolute zero and it does not require the equipment itself to radiate energy as with conventional radar. However, passive radar operates at far lower frequencies than infrared, down in the familiar microwave radar region. Passive radar receiver techniques and components more closely resemble those used in active radar than those used for infrared.

AFCRC Technique

Air Force Cambridge Research Center (AFCRC) here has pioneered the new technique, largely through in-house investigations, according to Dr. Joseph P. Casey of AFCRC's Propagation Laboratory. Sperry Gyroscope carried out a phase of the investigation, under AFCRC sponsorship. Bell Telephone Laboratories reportedly are also active in the passive radar field, but not under AFCRC sponsorship.

A comparison of the characteristics of the new passive radar with those of active radar and infrared shows some interesting advantages, some disadvantages:

• **No radiated energy.** Unlike active radar, whose radiated energy gives away its existence and position, passive radar matches infrared in its security from detection.

• **Longer range.** Passive radar, because it operates at microwave frequencies which suffer less atmospheric attenuation, has greater range than infrared. At longer wavelengths, like 3 cm. and 6 cm., passive radar experiences relatively little attenuation by rainfall. However, compared to active radar, the new technique may have somewhat less range against many types of targets.

• **Size, weight, complexity.** Passive radar is smaller, lighter, less complex than a complete active radar because the former requires no transmitter. However, passive radar is somewhat larger, heavier and more complex than an equivalent-function infrared system. Because of the lower operating frequency, a passive radar antenna is larger than an infrared scanner, comparable to an active radar antenna at the same operating frequency.

• **Resolution.** Passive radar resolution is inherently inferior to infrared because of its lower operating frequency, and its basic principle of operation makes it inferior to an active radar in this respect. Yet passive radar's ability to discriminate between different types of targets and backgrounds can be as good or better than either infrared or active radar.

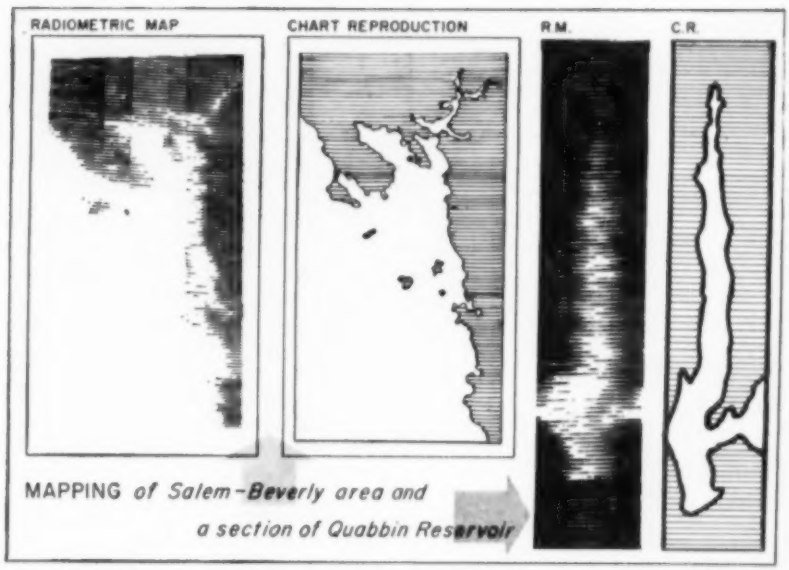
• **Response time.** Early experimental equipment used by AFCRC in its basic investigations, which employed conventional superhet circuitry and components, had relatively low response time and scanning rates compared to active radar and some IR systems. However, use of new traveling wave tube amplifiers in passive radar systems should provide a significant improvement in response time.

Other Air Research and Development Command centers are beginning to apply the new technique to specific hardware as AFCRC's basic studies shift to other areas.

How It Started

Passive radar techniques stem from World War II measurements of atmospheric absorption of K-band energy conducted at the Massachusetts Institute of Technology's Radiation Laboratory. R. H. Dicke and associates, using an adaptation of radiometry techniques previously developed for radio astronomy, chanced to deflect the antenna down so that it "looked" at the ground instead of the sky.

They discovered that microwave energy was being radiated from the ground and that its intensity varied when the antenna was pointed at different objects. This suggested the possibility of passive microwave surveillance. It was not, however, until about five years later when new microwave components and techniques appeared to make passive radar feasible, that AFCRC first began its investigations aimed at this specific objective.



PASSIVE RADAR maps, made with crude experimental equipment, shown alongside chart of same area, shows surveillance potentialities of new technique pioneered by AFCRC.

at Microwave Frequencies

Every object whose temperature exceeds absolute zero radiates electromagnetic energy not just in the infrared region but throughout the spectrum into lower frequencies. The bulk of the energy radiated occurs in the infrared region. (For example, nearly 90% of the energy radiated by a black body at a temperature of 27C lies in the infrared region above 30 microns; only a fraction of one percent of the total energy is radiated in the microwave region.)

Emissivity

As in infrared, the perfect microwave emitter is an idealized black body which absorbs all microwave energy striking it, thereby producing maximum possible radiation. In microwave radiometry, like infrared, the black body is used as a convenient reference. Also, emissivity is defined as the ratio of any object's radiation to that of an equivalent black body at the same temperature and always is less than 100%. (An object's emissivity at IR frequencies can be quite different from its emissivity at microwave frequencies.)

A non-black body temperature frequently is expressed in terms of equivalent black body temperature which is the product of its absolute temperature and its emissivity. Thus an object whose temperature is 300K and whose emissivity is 25% behaves like a black body radiator at 75K (25% of 300) and is said to have an equivalent temperature of 75K.

The microwave energy which a passive radar antenna receives when it looks at an object (assuming the object is large enough to fill the antenna beam) is the sum of radiation emitted directly as a result of the object's own temperature plus the microwave energy from the sky, or other sources, which is reflected from the object into the antenna's beam. The combination of these radiations is usually expressed in terms of "apparent black body temperature," sometimes as "equivalent antenna temperature" since this is the microwave radiation the receiver would see if the antenna were replaced by a matched load black body at this temperature.

To illustrate, a body of water whose absolute temperature is 300K (27C) and whose microwave emissivity is 45% will emit radiation equivalent to a black body whose temperature is 135K, i.e. (300) (0.45).

Sky Radiation

In addition, water reflects microwave energy from the sky whose equivalent black body temperature is around 50K. But not all of this sky radiation is reflected, only 55% of it (100% minus water emissivity). Thus the amount of sky radiation reflected is equivalent to a black body whose temperature is 27.5K, i.e. (50) (0.55).

A passive radar antenna aimed at the water would see the sum of these radiations so that the water would have an apparent black body temperature of 162.5K, i.e. 135+27.5K.

Because passive radar sees both direct emission and the reflected radiation, it is able to discriminate between two objects which are at essentially the same temperature but which have different reflectivities.

For example, consider the problem of discriminating between water and ground which may be at roughly the same temperature. Whereas water may have an emissivity of 45% and reflectivity of 55%, the figures for ground run approximately 90% and 10%, respectively.

The apparent black body temperature of ground at 300K, as seen by passive radar, would be equal to (300) (0.90) + (50)(0.10), or approximately 275K. This is 112.5K higher than the apparent black body temperature of water (162.5K) at the same absolute temperature.

Since the amount of energy radiated by a black body at long wavelengths is approximately proportional to the first power of its temperature, the energy radiated from the ground would be roughly 70% greater than that from water, more than sufficient to enable a passive radar to discriminate between the two.

Target Detectability

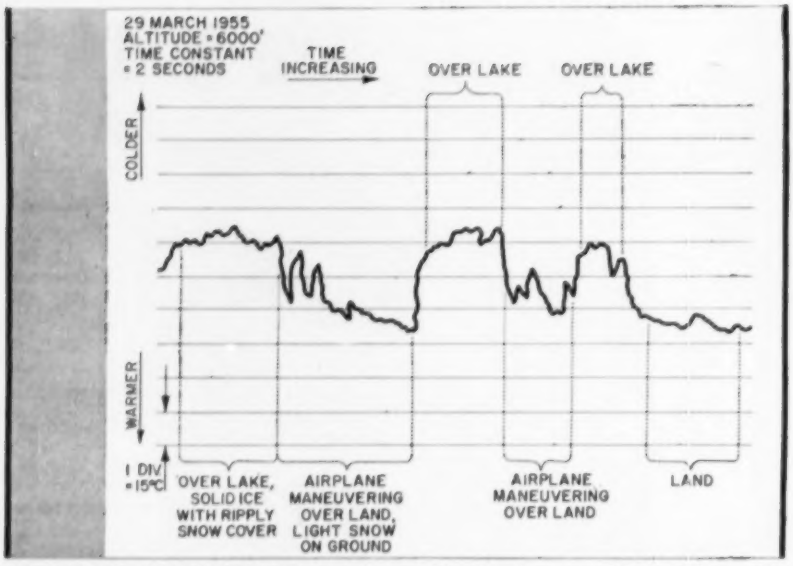
Passive radar's ability to discriminate between different objects under surveillance depends upon a number of factors, including:

- **Apparent temperature differential** between the objects.
- **Grazing angle** between antenna beam and the objects.
- **Antenna polarization.**
- **Antenna beam width.**
- **Receiver's minimum** detectable signal level, itself a function of several other factors.

The critical determinant, over which the system designer has no control, is the apparent temperature differential between objects under surveillance. Following are representative measurements made during an early AFCRC investigation, showing the apparent temperature **difference** between objects listed:

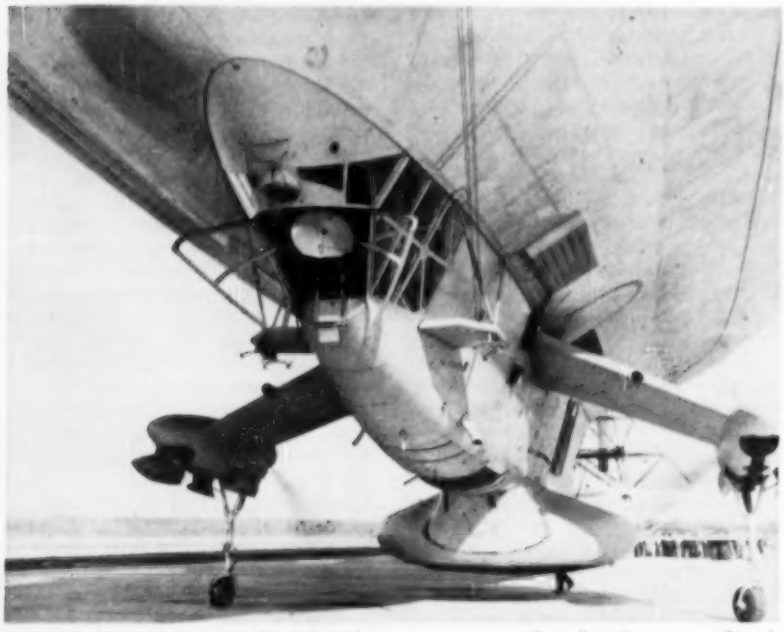
- **10K:** snow-covered ground and building.
- **10K:** building and sky beside the building.
- **41K:** snow-covered ground and dry ground.
- **19K:** dry ground and wet ground.
- **12K:** wet ground and top of automobile.

AFCRC investigations showed that the apparent temperature of smooth surfaces, like water, depends upon the angle from which it is viewed, i.e. the



APPARENT TEMPERATURE difference between land and water, which enables passive radar to discriminate between the two, is shown in recording of their radiation intensity.

PASSIVE RADAR resembles infrared but uses conventional radar receiver techniques. Block diagram shows experimental system used in early tests. Tactical equipment would use cathode ray tube in a PPI type display instead of recorder shown.



EARLY PASSIVE radar mapping and guidance tests were conducted at 8 mm. wavelength by Air Force Cambridge Research Center in Navy blimp. White paraboloid dish in open window is for mapping; white slotted antenna just below was used for guidance.

incidence angle of the passive radar antenna beam. Even more significant, the apparent temperature of some objects as seen by passive radar depends upon whether horizontal or vertical antenna polarization is used.

This polarization effect is most pronounced at small grazing angles; disappears when the antenna is looking directly down at the object. For example, smooth water at an absolute temperature of 293K has an apparent temperature of about 160K when viewed from directly overhead, regardless of the antenna polarization. At a grazing angle of 30 degrees, with vertical polarization, apparent temperature rises to 240K, an 80K increase. But if antenna uses horizontal polarization, apparent temperature remains at about 160K.

Grass, on the other hand, maintains the same apparent temperature regardless of antenna viewing angle or polarization. Asphalt black-top exhibits the same apparent temperature regardless of viewing angle when vertical polarization is used, but with horizontal polarization apparent temperature drops as antenna viewing angle changes from overhead to small grazing angles.

The foregoing suggests that the polarization characteristics of different objects could enable a passive radar to discriminate between them even when the two have nearly identical apparent temperatures when viewed from directly overhead.

Declassified Report

As pointed out in a recently declassified AFCRC report by Dr. E. A. Lewis, A. J. Vaccaro and Casey, "If it is desired to distinguish an asphalt runway from surrounding green vegetation, the line of sight (of the antenna) should make a moderately oblique angle with the asphalt and the polarization should be horizontal. The asphalt would then appear 'colder' than the green vegetation which appears 'warm' on both polarizations.

"Conversely, vertical polarization would be better for detecting flat metal objects (**Ed.** Such as vehicles) on the runway, since for practical purposes the metal is a very poor emitter of both polarizations while the asphalt radiates vertical polarization more strongly. For locating bodies of water in a wooded terrain, horizontal polarization and any angle of incidence within 60° of the perpendicular could be used," the report says.

The microwave radiation, or "signal" which must be detected by a passive radar receiver, is a form of noise with the same random fluctuating amplitude as the thermal noise generated within the receiver itself. The problem of distinguishing this signal from internal receiver noise is made more difficult by

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Circuit breakers

the fact that the signal level is extremely low, usually of an order of a millionth of a microwatt or less.

Signal detection is accomplished by inserting a square-wave chopping wheel (or ferrite modulator) between the antenna and receiver to alternately block and pass the signal from the antenna to the receiver. AFCRC's experimental receivers have used a chopping wheel rotating at 30 cps., or a ferrite modulator operating at 1,000 cps., to modulate the incoming radiation.

Using conventional radio astronomy (radiometry) techniques, the AFCRC receivers use a balanced crystal mixer fed by a reflex-klystron local oscillator to produce a 30 mc. or 60 mc. intermediate frequency signal which is amplified, then detected to produce an audio frequency signal at the chopper modulation frequency.

This signal is amplified in a bandpass amplifier, then demodulated using a 30 or 1,000 cps. reference signal synchronized with the chopper-modulator. The resultant signal is then integrated in a low-pass filter network.

In AFCRC tests, the d.c. output was used to operate the pen of a simple strip recorder to make an apparent temperature profile of the objects scanned. In a tactical equipment, the signal could be used to intensity modulate a PPI type of cathode ray display.

If radiation is to be immediately detectable, its magnitude must at least equal the peak-to-peak fluctuations in receiver noise, Casey points out. The theoretical minimum for a superhet receiver with a noise level of 10^{-12} watts would be about 10^{-16}, equivalent to an apparent temperature differential of one degree, when an integration time of four seconds is used.

In receivers used in AFCRC tests, which had 15 lb. noise figures and an IF bandwidth of 12 mc or less, apparent black body temperature differentials of two to three degrees could be detected with four second integration times, Casey says. (The RF bandwidth of the receiver was twice the IF bandwidth, or 24 mc., i.e. 12 mc. on either side of the local oscillator frequency.)

Because the minimum detectable signal level is inversely proportional to the square root of integration time, it is possible to trade off and use shorter response time where less sensitivity can be tolerated. For example, a passive radar used in one of AFCRC's airborne tests, operating at 8.6 mm., was able to discriminate between land, small water areas, runways and asphalt covered parking lots using a time constant of only 0.5 second.

Wideband Amplifiers

However, it has been the recent development of wideband, low-noise microwave amplifiers, such as the traveling wave tube, that has opened the possibility of using passive radar in high-speed aerial reconnaissance where even lower time constants are needed. Passive radar's minimum detectable signal level varies directly with receiver noise and inversely with the square root of predetection bandwidth, as well as integration time.

Some of the newer TW tubes have bandwidths of several thousand megacycles, compared to the 24 mc. or less RF bandwidth in experimental AFCRC receivers. Other tubes, with less bandwidth, have noise levels of around 6-7 db., compared to the 15 db. in AFCRC receivers.

Although TW tube designers have not yet achieved tubes with both extremely wide bandwidths and the low noise figures, there appears to be considerable hope for the future. Even with existing TW tubes, appreciable reduction in time constant is possible. The new Maser amplifiers, with extremely low noise, are another prospect.

Passive radar resolution, like that of active radar, depends upon antenna beam width, which is a function of operating frequency and antenna diameter. If an object does not fully fill a passive radar beam, its apparent temperature as seen by the antenna is

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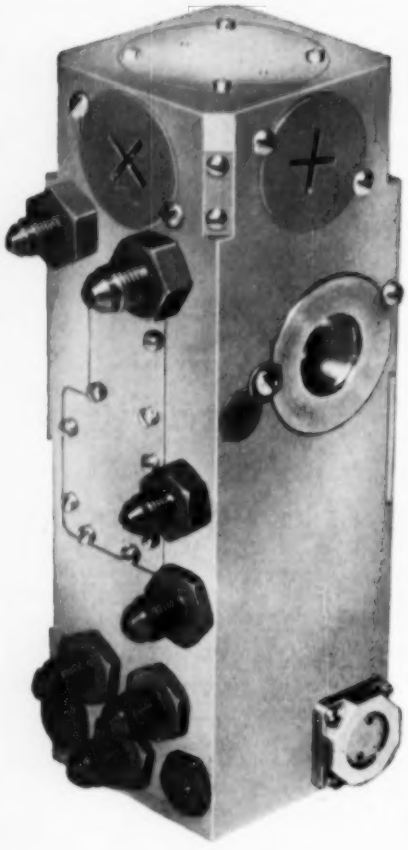

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Airborne Teleprinter

Airborne radio teleprinter, called Aero-Monatel, includes built-in all-transistor radio receiver operating in 100-150 kc. band, weighs 51 lb. including antenna. Receiver is crystal-controlled, has 120 cycle passband at 6 db. down points and a single-stage of 100 db. limiting prior to signal injection at crystal discriminator. Model 28 Teleprinter, capable of operating at 60 or 100 words/min. is incorporated. Unit operates from 28 v.d.c. and three-phase 115 v., 400 cycle power. Manufacturer: Westrex Corp., 111 Eighth Ave., New York 11, N. Y.

proportionally reduced to the percentage of the beam that it does fill.

Generally speaking the designer of a mapping radar seeks the highest possible resolution, but must balance this quest against the increased atmospheric attenuation that occurs at the higher frequencies. This is particularly true of passive radar which must utilize a signal that is extremely low level even without any atmospheric attenuation.

The relatively slower response time of passive radar is another factor which may set the upper limit on resolution, since a smaller beam must scan faster to cover a given area.

AFCRC has carried out passive radar tests at three different operating wavelengths, 8 mm., 1.25 cm., and 3 cm., while Sperry conducted similiar tests at 1.8 cm. Except for differences in atmospheric attenuation, Casey reports that there was no significant difference in performance at any wavelength.

Airborne Tests

AFCRC's airborne tests were conducted using a variety of vehicles, including a Navy blimp, a C-47 and an S-55 helicopter. The results of these tests were encouraging despite the fact that experimental and research type equipment was used.

For example, passive radar mapping was accomplished by means of a recording stylus moving across a waxed chart paper. When a signal indicating land was received, a voltage was applied to the stylus, heating it and causing it

Valve Talk

FOR WM. R. WHITTAKER CO., LTD.
BY MARVIN MILES

A Whittaker parking lot has disappeared and in its place has grown an intricate system of lines, tanks, valves and instrumentation—an extensive new test laboratory to assure that the company will meet and beat exacting demands.

John Fitzpatrick, chief project engineer, explains that the valve business faces more and more critical criteria—higher flows, greater pressures, hotter temperatures—it faces mandatory reliability far above that required in the past.

Aircraft are more and more susceptible to component malfunction. Where a failure used to be little more than a nuisance, today it can mean the loss of an airplane—and its crew.

The reliability requirements for missile units are even more exacting than those for aircraft, and Whittaker is moving ever deeper into the missile field.

"Today it is necessary to push engineering and development more than ever before," says Fitzpatrick.

"This means testing of the most exhaustive nature, a major factor in the modern valve industry. In the old days you used to static test an item and if it worked you produced it. Not today. Qualification tests and reliability programs require the most advanced laboratories. Test work can run as high as six to nine months or more, covering every conceivable trial within the span of operational ranges.

"Nor is it enough to test a prototype and a few production units now and then. The critical nature of supersonic and hypersonic systems demands that a great many more units be tested to assure the reliability of all units."

Whittaker's new test facilities have been constructed at a cost of about a quarter million dollars for testing fuel, hydraulic and pneumatic systems and components. Among the facilities for pneumatics testing are two compressors developing 100 pounds per minute at 125 p.s.i., plus two 100-pounds-per-minute boosters at 300 p.s.i. Heating capacity goes to 1200 degrees, and there is enough storage capacity to permit blowdown testing up to 1000 pounds per minute for test runs of 30 to 60 seconds. There are 18 individual test stations in the system for hot or cold air.

Also featured in these new facilities is the equipment with which to test high pressure pneumatic valves and regulators to 6000 p.s.i., while a husky system of tanks and lines is available for the testing of critical missile valves controlling liquid oxygen, gaseous oxygen, hydrogen peroxide, ammonia, etc.

The entire laboratory, with its maze of equipment, is designed for kitchen-clean operation, while the adjacent sanitized assembly room could be called almost surgically clean, with a dust-free controlled atmosphere where critical units are thoroughly cleaned in special baths and sealed in air-tight containers for shipment.

All the test systems are designed to exclude hydrocarbons and other contamination, with the lines being either internally coated or constructed of stainless steel.

And for the testing of extremely high pressure units, there is a heavily-reinforced bunker that will shelter laboratory workers against failure and blast. The systems also include a variety of simulator facilities, in addition to the altitude test rig, including vibration, heat, cold, fungus, sand and dust, etc.

The new laboratory also boosts the company's fuel test equipment and the physical space for such testing by some 200 percent. This now includes such items as water valve test facilities for 550 p.s.i. working pressures, and a fuel level control test stand. In addition, there is a special altitude test tank for testing pumps at altitudes.

While touring the lab, I was attracted by the different colors used to indicate the pressure extremes. I was a little surprised to learn that red represents a *low* pressure system. White, on the other hand, indicates a high pressure line or tank, with blue as an intermediate.

My surprised expression drew the simple explanation that if and when red (low pressure) trespassed into a white (high pressure) system, it would more vividly warn the test engineers of the impending blast.

Enlightened, interested, intrigued—most certainly; this was, nevertheless, my cue to terminate the visit!

to burn through the wax coating to expose a black undersurface. For this reason the quality of passive radar maps made by AFCRC is not indicative of the results that could be obtained from a passive radar system designed for tactical use.

Here are a few of the observations made during AFCRC's airborne tests:

• **Ships underway** in Boston harbor could be detected by passive radar because their wakes appeared warmer than the surrounding water.

• **Land-water boundaries** were clearly visible with a 1.25 cm. system at 6,000 feet altitude, despite a heavy fog extending from the ground which was so dense that the airplane's wing tips were not visible.

• **Automatic guidance system** for missiles or aircraft along land-water boundaries using passive radar techniques appear possible, based on limited AFCRC tests.

Hybrid Systems

The tactical advantage of using a non-radiating navigation, surveillance or mapping system to avoid enemy detection, which has focused so much military interest on infrared, appears certain to create similar interest in passive radar.

It is true that passive radar is more susceptible to enemy jamming than active radar or infrared. Yet it gains some security over active radar from the fact that the enemy does not know what operating frequency is being used.

Without too much increase in size, weight or complexity, it should be possible to design hybrid systems, using passive radar in combination with active radar or infrared, to give greater tactical flexibility than is available from the use of any one of the techniques.

FILTER CENTER

▶ **Hughes In Shopping Mood**—Hughes Aircraft, anxious to expand its non-military avionics business, is looking at small companies in the components and test equipment fields with the view to possible acquisition.

▶ **Russian Scatter Lags**—USSR technical publication indicates that the Russians are becoming keenly interested in trans-horizon communication but they appear to lag several years behind U. S. in the field.

▶ **New Insulated Wire**—"Fused-Film Wire" is name of new wire with Teflon film insulation measuring only 0.002 in. thick. Insulation reportedly has "200% greater dielectric strength and scrape resistance than any comparable insulation," according to Adam Consolidated Industries, Union, N. J. Insulation is said to be stable when temperature cycled between −200F and 500F and can withstand 6,000 volts.

▶ **New RETMA Name**—Radio Electronics-Television Manufacturers Assn. will adopt new name, Electronic Industries Assn., if majority of members approve in up-coming ballot.

▶ **Weather Radar Short Course**—Massachusetts Institute of Technology will conduct a short course, Aug. 12 through 23, on weather radar and its application as a meteorological tool for forecasting. Course is designed for both radar engineers and meteorologists to acquaint each with the other's problems and achievements. Tuition is $250. Program will be under supervision of MIT's Dept. of Meteorology.

▶ **Radar For Australia**—Two largest Australian airports, at Sydney and Melbourne, will be equipped with British Cossor C.R. 21 surveillance radars.

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heights of 1⅛, 2, and 2½ in. Typical rating for smallest size is: 30 volts, 1,000 microfarads, polar construction, etched foil. Larger units are rated at 50 v. General Electric Co., Capacitor Dept., Hudson Falls, N. Y.

• **Transistorized d.c. polar relay,** Type MYZA, new version of Micropositioner relay with built-in pre-amplifier which greatly reduces magnitude of required input signal. New relay comes in three models: "M"—a latching type which remains in last position when input signal is removed; "K"—a null-seeking type

relay, and "C"—with snap-acting calibration. Bulletin F-7754-2 gives application data. Barber-Colman Co., Rockford, Ill.

• **400-Cycle frequency meter,** Model 200, for aircraft instrument panels, provides accuracy of 0.25% over temperature range of −55C to 70C. Meter is

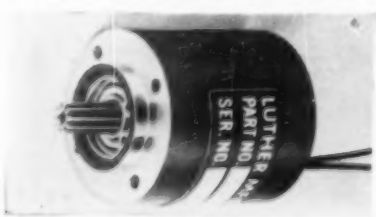
designed for 115 v. operation and dial is calibrated from 392 to 408 cps. Consolidated Avionics Corp., Stamford, Conn.

• **Precision size 11 resolver,** measures 1.062 in. dia., is available with accuracy of better than 0.1% for operation at

frequencies of 400 to 1,600 cps. Application data is available from Reeves Instrument Corp., 207 East 91st St., New York 28, N. Y.

• **Corona type voltage regulators,** with current ratings up to 4 ma., are now available for military applications in T6½ and T9 envelopes in voltage ranges below 3,500 v. Application data is available from The Victoreen Instrument Co., Components Div., 5806 Hough Ave., Cleveland 3, Ohio.

• **Miniature hysteresis synchronous** motor, in size 10 frame (1 in. dia.), is



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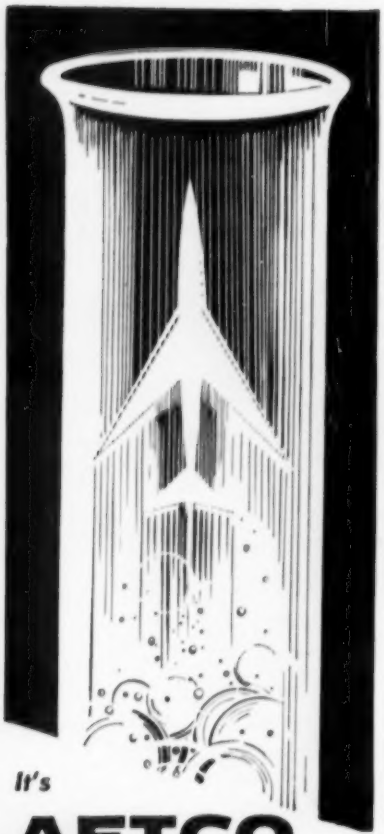

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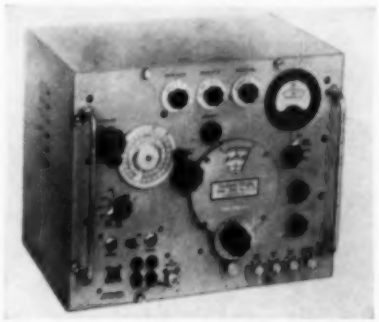

generated. Output includes two separate synchronizing signals. Delay circuit permits RF output to be delayed an adjustable interval after undelayed synchronizing signal. Transitron, Inc., 186 Granite St., Manchester, N. H.

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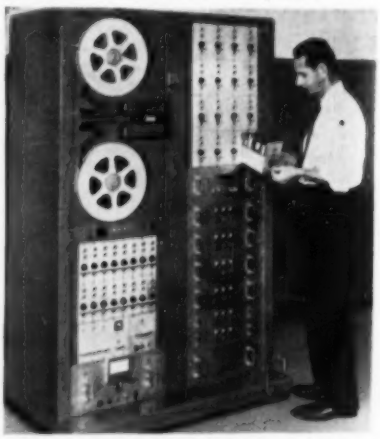


handle real sizes up to 14 in., or up to 19 in. if so desired and can accommodate ¼, ½ or 1 in. wide tapes. American Electronics, Inc., Recordata Div., 655 W. Washington Blvd., Los Angeles 15, Calif.

• **Axial accelerometers,** with high-resolution potentiometer pick-off, are available in ranges from ±1G to ±40G with undamped natural frequency ranges from 7.8 to 54 cps. Units are hermetically sealed and oil damped, designed to withstand rugged environment and to provide low crosstalk (0.01G/G maximum) and threshold. G. M. Giannini & Co., Pasadena, Calif.

SECOND ORDER aided tracking allows one operator controlling theodolite with small control stick (left) to track more accurately in vertical, horizontal planes. Stick movement produces acceleration not velocity. Ring sight (right) is needed because of narrow vision field.

Optical Tracking Data Speeded By Human-Engineered Theodolite

Van Nuys, Calif.—Prototype optical tracking theodolite designed to eliminate the data reduction bottle-neck by offering near on-time digital read-out has completed acceptance tests at Naval Air Missile Test Center, Point Mugu, Calif.

Its designers assume an economic demand exists for such equipment because manual reduction of tracking data from a five minute run may require from four weeks to two months. Range schedules and government contract requirements often demand one or more missile test firings per month which means that tests are sometimes run before the lessons of the previous firing have been assimilated.

Human-Engineered

The new device, called RADOTT (Recording Angular Data Optical Tracking Theodolite), makes extensive use of human engineering principles to reduce operator errors. These errors have obliged designers of earlier optical trackers to rely on photographic read-outs on film strips taken of the target that allow data reduction crews to correct angular errors by measuring deviation of the target from center on the film frames. RADOTT was designed by the H. A. Wagner Co. here.

The prototype was designed and built under a Navy study contract administered by NAMTC Point Mugu. Navy felt the principle should be evaluated in operation and project officers say they are satisfied with the basic theodolite. It has not been tested with the data reduction system.

Automatic data reduction requires a network of units transmitting bearing information to a central computer for triangulation of a running fix at quarter-second intervals. This can be presented most accurately in tabular form by a digital computer. Time lag in reading-out digital data is a half-second or less.

For some purposes, analog calculation is best. It is less accurate but one of its advantages is the ease with which a direct graphic presentation can be made. Another is on-time read-out for those cases where it may be desirable to modify the flight program during its course or where other instruments may be slaved to the tracking net.

The automatic data reduction system could not be tested in the recent trials because only prototype theodolite has been built. Since the test was of the theodolite alone, angle read-outs on the prototype were recorded by photographing numerical counters.

One objection to the RADOTT has been that it makes the operator's reliability an uncontrolled factor in the accuracy of the instrument. At short ranges, the seven-power scope and the accuracy of the instrument demand that the crosshair be held on a specific point such as a wing root or rudder tip. Without photo verification there is no way of being certain that all operators hold on the preselected point.

Another advantage of filming the run is that photos can be checked for data on altitude, control deflection, failure of structure, etc. To counter these objections, a camera installation for RADOTT is now being studied which would provide a check on the automatically processed data and would make available other data than track, velocity and acceleration.

The theodolite was first proposed to Mugu by Wagner in 1952. Prototype development began in 1954.

Increasing Complexity

The RADOTT represents the second phase in the increasing sophistication and complexity of optical trackers from the completely manual, two-operator, handcrank controlled theodolite. The first advance was first order aided tracking in which servo motors swing the theodolite at a given angular velocity for a given displacement of the control and which provides the operator with a seat that swings with the instrument rather than forcing him to walk around the instrument as it swings. All of the first order aided tracking devices retain two operators and are sufficiently inaccurate to require photographic read-out and correction during the manual data reduction.

The RADOTT uses second order aided tracking in which the rotation of the line of sight corresponds to the sum of the control deflection, an in-

tegral of deflection and a second integral of deflection with respect to time so that a constant deflection causes a proportional constant angular acceleration and a neutral control position produces a constant angular velocity. Wagner engineers consider this an important innovation as a constant target angular velocity is most rare. The only target motions which require a positive response on the part of the RADOTT operator are variations in acceleration. A constant velocity or constant acceleration target is no more difficult to hold than a target at rest.

A rational approach to the human operator's capacities has also yielded worthwhile advantages. They stem from three principles:

- **A certain amount** of tracking error is a necessary evil.
- **Some part** of operator error is predictable and can be derived from control motion and added to the basic instrument response to produce a more accurate result.
- **When any easily** predictable motion appears in the tracking task, the operator's time lag increases and efficiency falls off. In responding to high frequency or rapid onset variations, the operator is at his worst if he functions as a thinking being.

The human operator's tracking error is limited to high frequency, low amplitude variations by giving the instrument a response time that is substantially shorter than that of the operator and by planning the operator's physical task so that physical response time is minimized relative to visual and mental reaction time. The effect of this is to allow him to act before he thinks, thereby cutting his response time to about 170 milliseconds.

Alerts Operator

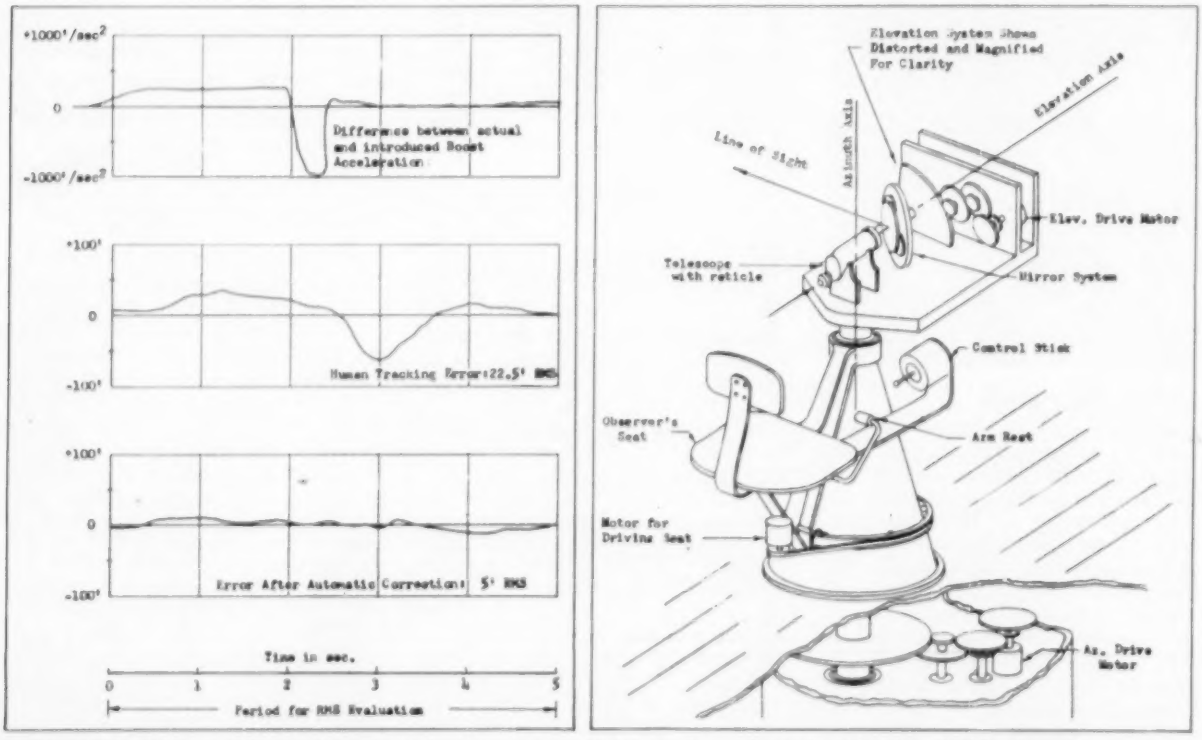
A considerable tracking error remains to keep the operator alert. Much of this is predicted and compensated by a tracking error computer to reduce angular error in the read-out to a level approaching human powers of visual resolution. At long range, visual resolution is actually the limiting factor in RADOTT accuracy. At short range, the target fills so much of the visual field that holding the crosshair on a poorly defined sighting point on the target body becomes more significant.

As a result, linear accuracy in terms of feet and inches is relatively independent of range, but is ordinarily best at medium ranges of 10,000-20,000 ft. The slight deviation not eliminated by the tracking error computer corresponds to "noise" in the human circuitry.

Second order aid plays an important part in cutting human response time. By linking control deflection with instrument acceleration rather than velocity, it greatly reduces the magnitude of control and hand movements needed to cope with rapid changes of target course and speed. RADOTT designers took advantage of this by using a small, pencil type control stick rather than the big steering wheels used in other aided tracking devices. Since the pencil control stick requires only one hand, a single operator can use it to track in both azimuth and elevation. Because of the small mass and flexibility of the wrist and fingers, the pencil control has the advantage of the quickest usable bodily response. Designers of the RADOTT have taken care to keep the mass and centering pressure on the stick low so as not to inhibit fast fingertip responses.

Servo motors rotate the theodolite in azimuth and elevation axes to follow large amplitude, low frequency motion but the large masses which must be accelerated prevent the servos from following high frequency low amplitude variations. This component of target track is handled by a light, flat mirror which can be tilted rapidly about both axes by servo magnets following commands from the control stick and which reflects the field of view into the scope through an angle of about 90 degrees. Any mirror deflection from neutral causes the servos to follow in an attempt to eliminate the deflection. Mirror deflection is limited to ±2 degrees.

Open loop programming of the anticipated tracking task eliminates one more predictable element. The operator's responsibility is then limited to



TOP CHART (left) shows difference between acceleration programmed into tracker and actual acceleration. Middle chart shows operator error, and the lower the amount of error remaining after computer has eliminated predictable error. Drawing (right) shows tracker details.

Six of the Lockheed models now in flight test: T2V-1 jet trainer, WV-2 radar search plane, F-104 jet fighter, 1649 Starliner commercial transport, WV2-E radar search plane, P2V-7 Neptune patrol bomber.

Flight Test Engineering – *the dynamic field for engineers*

A statement by R. L. Thoren, Chief Flight Test Engineer, California Division, Lockheed Aircraft Corporation

The technology of flight test engineering requires an engineer of special ability and aptitude.

There are always a large number of aircraft demanding the ingenuity of professional flight test engineers in a company as diversified as Lockheed. At present there are 30 aircraft – 12 different models – on hand for extensive flight test engineering. In addition, the Electra program, small jet transports and other significant projects will soon swell our schedule.

A major flight test effort such as this calls for an engineer who is flexible, able to cope with changing assignments that vary widely in complexity and approach. He must be able to engineer on his feet; the desk-bound man is out-of-place in as dynamic a field as flight test. Moreover, he must possess ability in breadth. He is no specialist in a single phase of engineering. His assignments cover the entire aircraft. And as flight testing begins in preliminary design under our philosophy of engineering, he participates actively in design and development of all Lockheed aircraft from that stage through completed testing. Needless to say, a flight test background at Lockheed helps qualify an engineer for virtually any key engineering position in the company.

Our expansion program has created new positions for Flight Test Engineers, Flight Test Analysts and Instrumentation Engineers with those attributes. Many of the positions are on a senior level and will particularly interest engineers with flight test experience. I have asked E. W. Des Lauriers, manager of our Placement Staff, to give your inquiry his fullest attention.

Architect's drawing of Lockheed's new Burbank flight test engineering and experimental center. It is scheduled for occupancy September, 1957.

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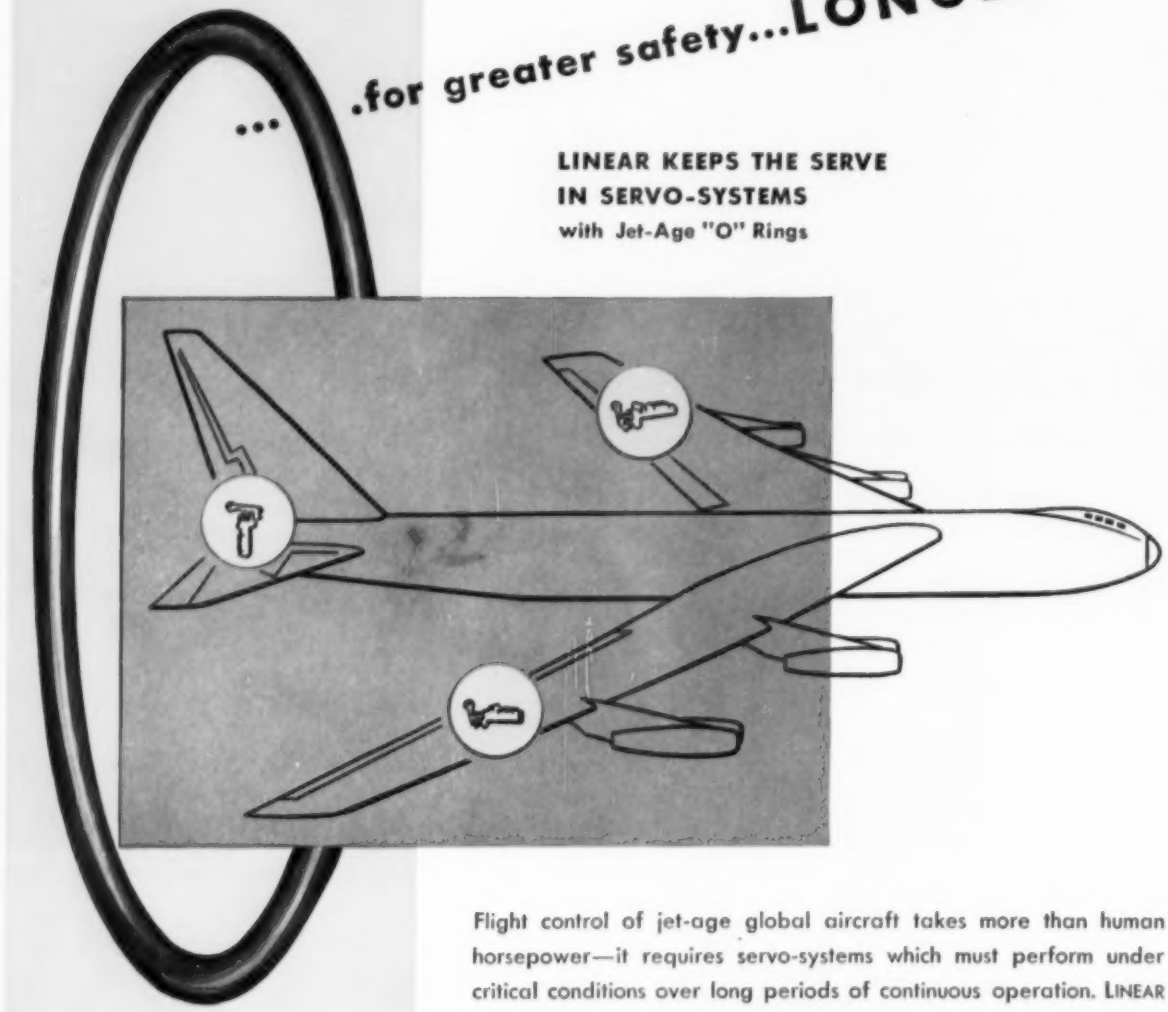

Flight control of jet-age global aircraft takes more than human horsepower—it requires servo-systems which must perform under critical conditions over long periods of continuous operation. LINEAR has developed "O" rings and seals that keep the serve in servo-systems—to keep these planes in the air longer—safely.

For these critical requirements, LINEAR developed precision "O" rings molded of the newest elastomers to meet the most rigid specifications. They will withstand temperatures of from −130° to 550°F —give long service life under severe mechanical abuse—and will withstand the destructive action of such fluids as silicate and phosphate esters, hydrocarbons and synthetic lubricants.

When it's a sealing problem, call on LINEAR or one of its agents for engineering assistance . . .
and be sure to specify LINEAR "O" Rings.

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Mobile Tracker Delivered to ARDC

Telescopic photographic recorder, described by manufacturer as first completely mobile optical tracking system, is being tested by the Air Research and Development Command at Air Force Armament Center at Eglin AFB, Fla. System, built by Perkin-Elmer Corp., Norwalk, Conn., consists of a 9 ft. long 100 in. focal length reflecting telescope equipped with a 70 mm. motion picture camera, which, with two sighting telescopes, controls and equipment, is mounted on a four wheel modified 90 mm. gun mount. Primary telescope lenses can be changed to accommodate 200 or 300 in. focal lengths. It can be operated remotely or by operators.

following deviations from the planned target flight. Anticipation of the target's track does not have to be especially accurate for this technique to be profitable. This is especially true during the boost phase of missile flight when high, rapid onset accelerations would make tracking error understandably larger. Fully automatic tracking of only fair accuracy greatly reduces the magnitude of manual corrections required of the operator. The boost period is a critical time during a tracking operation as failure to hold the target during violent accelerations may unnerve the operator and ruin his effectiveness for the remainder of the run. The open loop program can be triggered by a firing pulse from the launcher or the whole test run can be sequenced by the synchronization pulses usually transmitted by range communication systems.

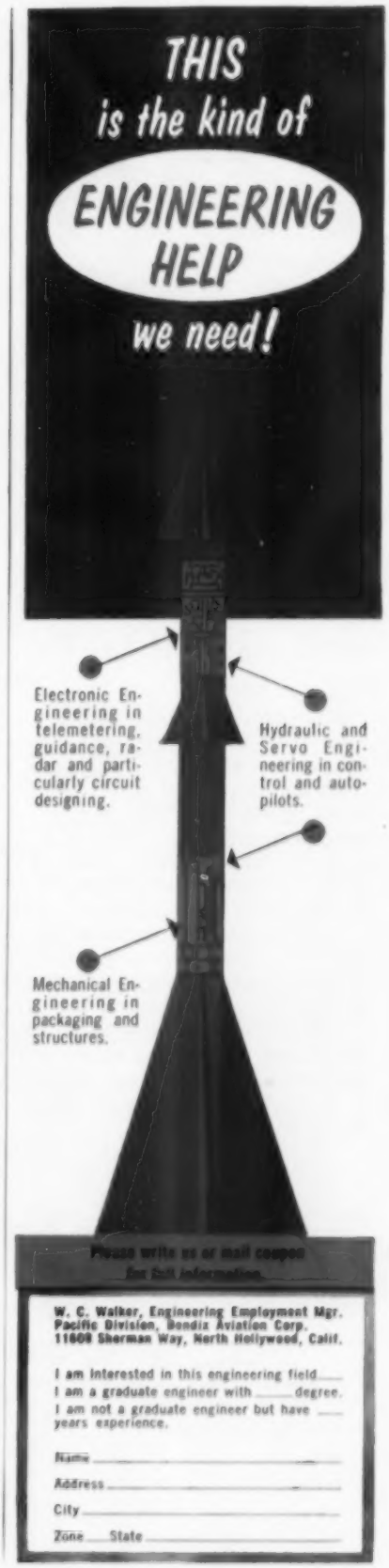
Tracking Tolerance

For a smoothly accelerating target, RADOTT can track within 0.1 angular mil. The RMS accuracy is about .05 mils.

Linear error for an unpredictable constant rate of acceleration is 1 ft./G/sec. At a range of 80,000 ft., tracking error due to limits of visual resolution is seven feet.

The new tracker has a 360 deg. tracking field in azimuth and an elevation field from −3 degrees to +70 degrees. Maximum angular tracking speed is 30 deg./sec. around both axes, though the 12,000 rpm servos are actually capable of swinging the theodolite at twice that rate. Maximum angular acceleration for the servo driven main shafts is 15 deg./sec./sec. The mirror is capable of angular accelerations of 100/deg./sec./sec. within its limited range. Shaft digitizers in the data readout will resolve one revolution of the slow speed main shafts into 128,000 parts.

The narrow 7 deg. field of vision of the RADOTT scope raised the problem of target acquisition. It is undesirable for the operator to use the scope for this because of the low probability of placing a distant or fast moving target within such a small area. With second order aided tracking, prolonged hunting in an area of blue sky without fixed visual references will result in the instrument accelerating to terrific angular velocities of which the operator is unaware because of the small stick deflection required to produce them. If this angular swing has a vertical component, the instrument will crash into its stops and declutch. If, by good fortune, the scope should actually swing across the target, the operator would probably not see it because of the speed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A4D Goes to Sea Duty

Douglas A4D-1 Skyhawk of VA-34, a special weapons squadron, flies on navigation hop over Florida. Squadron will be first A4D squadron to join fleet at sea.

with which it would cross his field of vision.

One target acquisition device which was tried was a reversed scope of equal power that could be inserted in the optical system. This failed to work out because the combined lens aberrations ruined the quality of the picture. The solution finally suggested by the Navy project officer was an external interference ring sight which diffracts the natural light into colored Newtonian rings having an angular diameter controlled by the properties of the sight materials and which is independent of the distance from sight to eye. Since the operator has an unrestricted field of vision, it is quite easy for him to place the sight upon the target before switching to the eyepiece.

Wagner expects to be able to market the new theodolite in quantities of 10 for less than $100,000 each.

Red Bird Target Maker Goes Out of Business

East Coast Aeronautics, Pelham, N. Y., has been liquidated by its parent company, Barium Steel. The firm had employed 300-400 persons.

"With only 70,000 sq. ft. floor space East Coast would fill up its shop with only four jobs and if there was a delay in one of these jobs it would begin to loose money" a Barium spokesman said. "It was a matter of either expanding to 200,000 sq. ft. or liquidating."

In view of the cutbacks in military subcontracts and the tendency of prime contractors to absorb the cutback by taking back work into their own shops, it was decided that it would be wisest to liquidate.

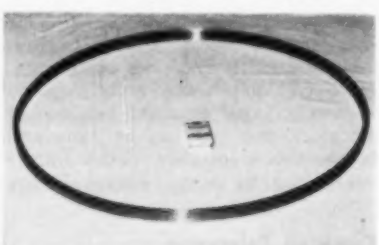
East Coast's Red Bird tow target has been sold to Liberty Aircraft, Farmingdale, N. Y., a subsidiary of the Penn-Texas Corp and its fuel filler cap business has been sold to Federal Manufacturing and Engineering Co., Garden City, N. Y.

The Redbird tow target was one of East Coast's most successful projects. Fifty were built for USAF and a few more for the French and other NATO countries. A supersonic Redbird is now being evaluated at Eglin AFB, Fla.

Facility Planned for Testing Suppressor

Sound suppressor-thrust reverser for Boeing 707 will be tested at a new facility at Boeing's Renton, Wash., transport Division plant. Work on the $300,000 facility will begin immediately after contract signing and should be complete sometime this fall.

It will consist of two ground run-up silencers. Company said outside noise



Thrust Reverser Seal

This is a prototype of a bellows seal made for Boeing Airplane Company's 707 jet engine thrust reverser. Unit is 33 in. in diameter, 1¼ in. wide and will seal with a total deflection of .140 in. Seal will operate at temperatures up to 1,150F. It weighs 3 lb. 3 oz. Manufacturer: Skinner Seal Company, 3001 Sutter Street, Santa Ana, Calif.

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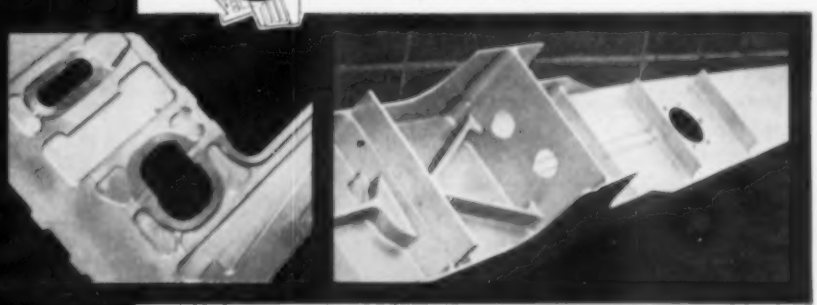

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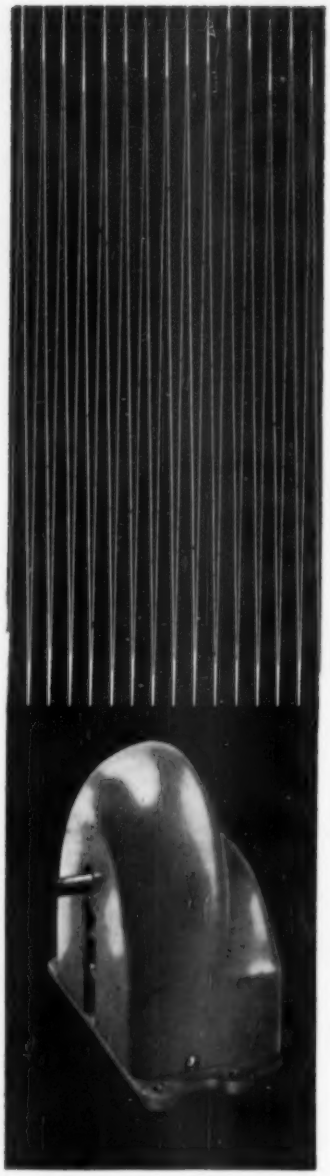

Select the new Lyndon non-friction, non-hydraulic damper and you'll select the ultimate available for protection *against all undesirable outside forces.*

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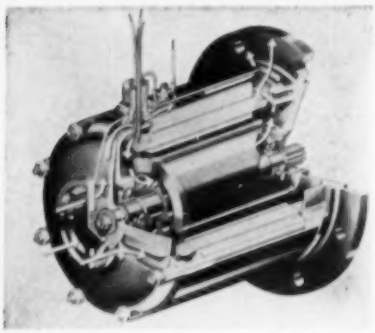
level should be reduced to "that experienced inside a fast-moving car." Silencer tubes are 45 ft. long, 12 ft. in diameter and are mounted upon an 85-ft. x 160-ft. concrete slab. Test engine controls and instrumentation will be located in a 40-ft. trailer between the two units.

Boeing originally planned to build the test stands at Moses Lake Flight Test Center, but sound reduction of the upward exhausting silencers appears good enough to locate the units at the Renton plant.

Flight testing of the thrust reverser-sound suppressor is scheduled to begin this summer.



SECTIONAL view of new Jack & Heintz aircraft a.c. motor shows cooling air flow.

Flexible Range of Motors Developed

Wide line of "flexible standard" a.c. electric motors for aircraft which will slice delivery time in half is under development at Jack & Heintz, Inc.

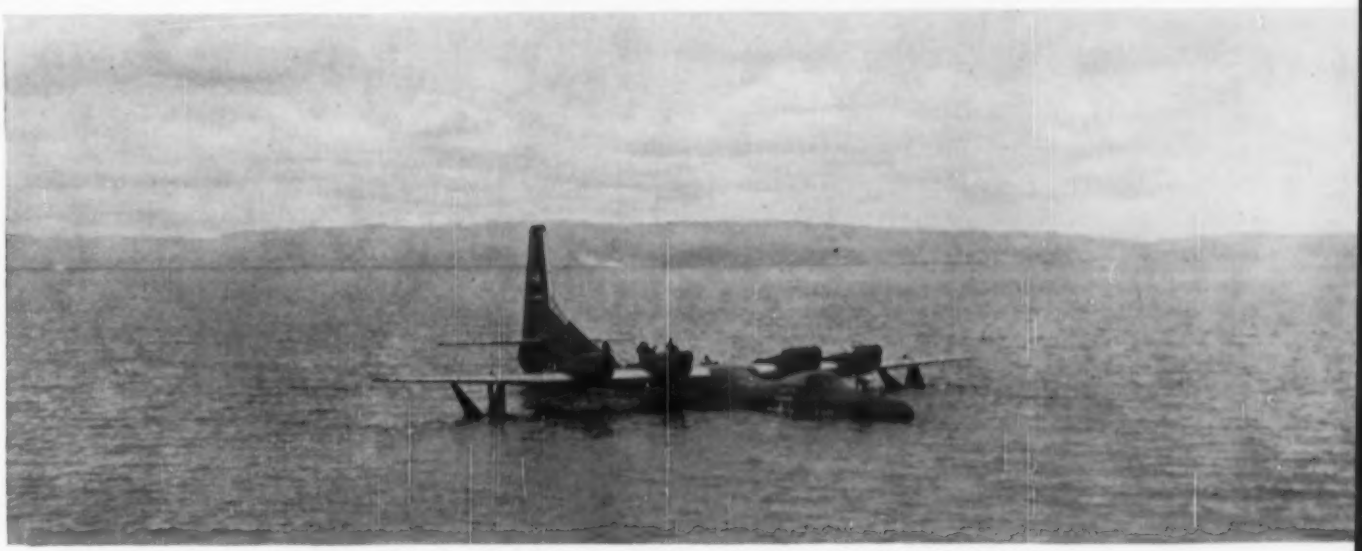
Nucleus of the line will be made up of over 40 motors ranging in size from ½ to 25 hp. in SAE frames IV, V and VI.

Initial production is expected to start in August.

Closures will be available in four types: continuous duty—open ventilated; continuous duty—totally enclosed, fan cooled; intermittent duty—totally enclosed; intermittent duty—totally enclosed, with brake.

Laminations are being designed for 8,000 and 12,000 rpm. synchronous speeds with provisions for extension to other speeds. While design of the line of motors follows SAE standards quite closely, J&H says it is making significant reductions in weight and size of the units.

Company cites these examples of continuous duty, open ventilated motors. An SAE motor weighing 7.72 lb. will weigh 4.80 lb. in the J&H version; a 9.26 lb. model drops to 7.0 lb. and a 25.5 lb. motor comes down to 17.8 lb. if the casting is aluminum or 16.95 if magnesium.



CONVAIR R3Y-2 Tradewind rests on the bottom of the bay, three-fourths submerged, with a 9x14 ft. hole in hull.

Small Turbines Salvage R3Y-2 In Bay

Salvage of Convair's 80-ton R3Y-2 Tradewind flying boat—which had a 9 x 14 ft. hole torn in its hull during a recent emergency landing brought on by a runaway propeller on its number-three engine—was accomplished by pumping out most of the water in the hull with air supplied by two small gas turbines.

The plane had come to rest on a mud bottom three-fourths submerged in nine feet of water in San Francisco Bay. To salvage it, a crew from the Alameda Naval Air Station first sealed the hull, except for the gaping hole in the bottom.

Plane was lightened by draining its fuel and removing the turboprop engines and propellers.

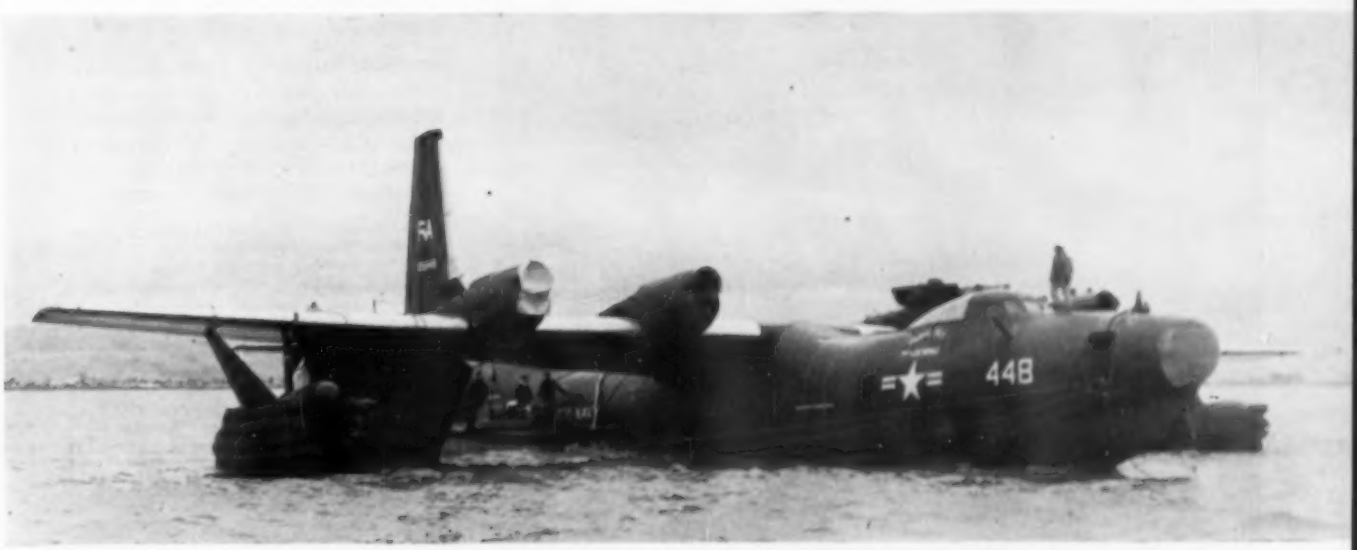
Then air supplied by the two GTC 43/44 Airesearch gas turbines through a common y-shaped duct was piped into the hull. In a few hours, the plane was broken loose from the bottom and raised until only 18 inches of water remained in the hull.

One gas turbine was then shut down and the big flying boat remained afloat on air supplied from the remaining turbine. As a safety measure, wings of the plane were buoyed by air bags to keep it afloat in case of failure of the air supply or other contingency.

The 14-mile trip back to the Naval air station was made in six and a half hours via tow by Navy salvage ship. During the tow the boat carrying the compressors served as escort and the air pressure was maintained.

Communications between the damaged flying boat and the tow ship were maintained with portable electronic megaphones. Airplane was beached but 65 hours after its emergency landing.

The flying boat is based at Alameda Naval Air Station, where it will undergo repairs. None of its crew was injured seriously in the landing.



AFTER 80-ton seaplane was raised, wings were buoyed up with inflated air bags in case of leak or compressor failure.

Flight deck crew prepares CS2F, a Grumman Tracker built by de Havilland of Canada, for launching from steam catapult of new Canadian carrier, Bonaventure.

Bonaventure Flight Trials Begin

Banshee jet fighter is catapulted (above) during flight trials carried out by Bonaventure in United Kingdom waters. Angled deck carrier (below) was built by British. Two Banshees and two Trackers were brought aboard for the cruise. They were flown overseas from Canada for the operation.

4 IMMEDIATE OPENINGS FOR ENGINEERS

Senior Structures Loads Engineer. To determine air and ground loads, airframe temperatures, carrier suitability of aircraft, and repeated loading criteria. Requires engineering, math or physics degree, with 3 or more years experience.

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Instrumentation Engineer. For missile test program. To provide technical direction for operation, maintenance and development of flight test telemetering equipment. Requires engineering degree plus 2 or more years related experience.

Inertial Guidance Systems Engineer. For key role in developing guidance system flight test techniques. B.S. in Electrical Engineering or Physics, experience with gyros and accelerometers or digital computers.

To arrange for a personal interview, or for a prompt report on these or *other current openings*, return coupon to:

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The development engineer who exercised his option

When it comes to end products, Bill Crowder never finishes what he starts.

While Bill's colleagues were bringing to completion a missile that he initiated, Bill helped launch eight other major projects and some minor studies. A restless record. But that's his privilege in Chance Vought's Development Section.

Bill's department analyzes requirements for new weapons. Specs come from the military, or from Vought's own Advanced Development Planning Group. They outline an approaching void or shortcoming in our defense structure. It's up to Bill and from three to thirty project teammates to produce an idea that will fill the vacancy.

From Development's desks and bull sessions come new configurations. Some are radically different; others, close to conventional. The best are projected, electronically, into the environments they must dominate.

For example, Bill can forecast a proposed missile's flight behavior by studying analog traces and columns of IBM tabulations. Electronically, he can observe minute performance details such as gust effects on a recoverable missile's landing approach.

Tests like these refine from Bill's own offerings and those of others the configuration that best answers the problem. Once this pattern is "ballparked" for approximate actual size, it's ready for detail design . . . likely to become a full-scale project.

Time now for Bill to exercise an option all Vought development engineers enjoy. He may follow the project he's begun the full route to completion. Or he may remain in Development and accept a new assignment.

To himself, Bill justifies his choice something like this: "Changing assignments gives me a chance to shift gears . . . to change my approach . . . to broaden myself."

To project engineers, anxious for him to follow a promising project out of Development, Bill's "no thank you" is practically a matter of course.

They know he's already cleared his desk for the next new challenge.

At Chance Vought the Development Engineer explores a unique variety of configurations and operational environments. He may limit his analyses of land- and sea-based weapons to preliminary design studies, or he may accompany his project through the complete development cycle.

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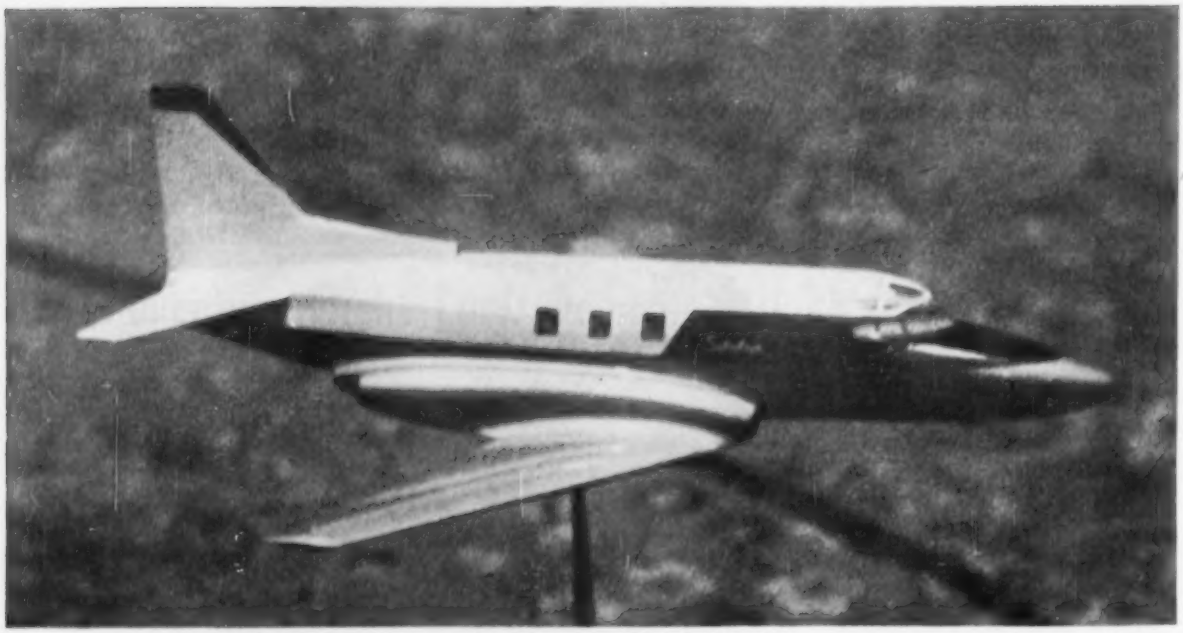


NORTH AMERICAN SABRELINER four-passenger trainer/transport, which should be flying early next year, is shown in model form. Twin GE J85s are cowled in long nacelles atop the swept wings; extended tailpipes will carry exhaust noise well behind cabin area.

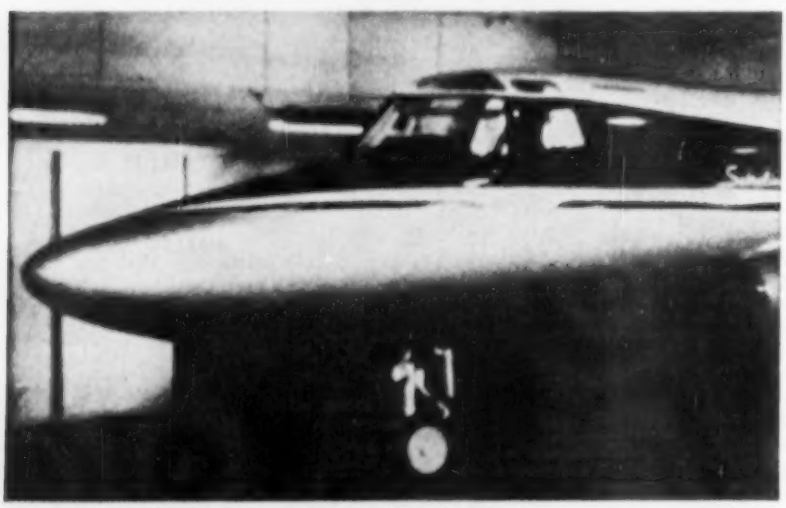
Lockheed, North American Stir Jet Race

Los Angeles—Lockheed and North American have taken a large lead over other industry contestants in development of a new light jet utility transport and crew readiness trainer for USAF.

Configurations of the new airplanes are shown in exclusive AVIATION WEEK photos on these pages, taken during recent first public showing of films of the Lockheed and North American entries. Like the other entries in USAF's development program for these classes of aircraft, the planes are being designed to meet Civil Aeronautics Administration requirements to suit them for use as high-speed business transports (AW Feb. 13, 1956, p. 32).

Films depict full-scale mockups of the two West Coast designs. Lockheed's new CL-329 transport undoubtedly will be the first to fly—the company has set a mid-September target date for initial flight of its prototype—and North American has started cutting metal on its smaller twin-jet Sabreliner, AVIATION WEEK learned. Tentative completion date is next February and first flight will be in March, informed sources say.

Both airplanes are planned around the new General Electric J85, weighing 298 lb. dry and delivering approximately 2,500 lb. thrust.



RADIO-NAVIGATION "black boxes" will go in Sabreliner's long nose to ease accessibility.

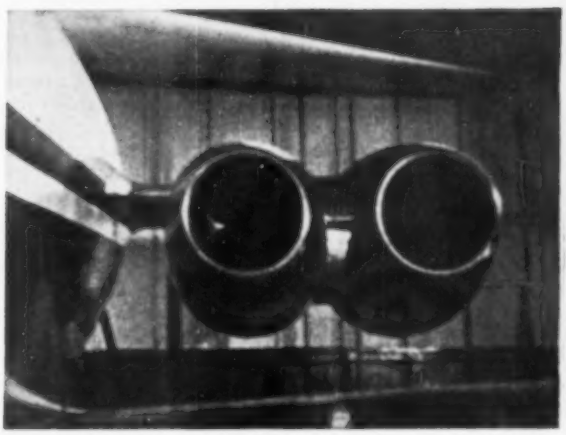
Design Details

• **Lockheed CL-329** is a swept low-wing 10-passenger configuration, with wings clean because the four engines are mounted in side-by-side pairs on the rear fuselage, the inboard pod being separated from the fuselage by approximately one pod diameter. This engine location is designed to provide a minimum noise level in the cabin and as a safety factor, the turbine wheels are located well behind the cabin pressure bulkhead. In event of a wheels-up landing, engines would be protected by the belly and low-set wing.

Twin-engine version of the Lockheed CL-329 powered by Bristol Orpheus turbojets in the 4,500-5,000 lb. thrust class each, will take to the air first, AVIATION WEEK learned. The company planned the CL-329 around both four J85s and a pair of Orpheus jets, according to informed sources.

Stabilizer, of the "all-flying tail"

CLEAN SWEPT WING of Lockheed CL-329 (model left and right) is possible through placement of jets on aft fuselage, which also protects engines in event of wheels-up landing.



POD-MOUNTING closeup (left) of twin J85s on side of Lockheed CL-329 shows connecting strut. Prototype will fly in mid-September with single Bristol Orpheus jet on each side. Entrance to cabin (right photo) is well clear of rear-mounted jet pods.

type, is mounted approximately one-quarter of the way up the fin and has sweep similar to the wing.

Cabin is air-conditioned and pressurized to maintain 8,000 ft. altitude when the CL-329 is flying at 45,000 ft. The airplane has ample accommodations for baggage and a galley.

Grossing 28,000 lb., the transport will cruise at 500-550 mph. at 25,000 ft. to 45,000 ft. and will have a range of 1,500 mi. at these altitudes without installation of auxiliary fuel tanks.

• **North American Sabreliner** seats four plus crew of two, although the company has plans for a high-density version seating nine passengers, and a cargo model. Designed to meet Civil Air Regulations part O4b, the Sabreliner has its pair of J85s located in the wing roots, with tailpipes extending well aft of the swept wing's trailing edges. A retractable inlet screen extends to protect the engine from foreign object damage whenever the landing gear is down.

Sabreliner has single-point refueling system with opening in the top of the left engine nacelle, easily accessible from ground level at the wing trailing edge. Radio and navigation "black boxes" are mounted in the nose and are accessible from ground level.

Cabin pressurization, like the Lockheed CL-329, provides 8,000 ft. altitude while the Sabreliner is at 45,000 ft. In addition there is an emergency oxygen system for each passenger. Wing and stabilizer leading edges incorporate thermal anti-icing.

Sabreliner cruise speed is planned at Mach .76 at 39,000 ft.; maximum speed is expected to be 540 kt. Single-engine ceiling will be 23,000 ft. and range 1,200 nautical miles, extended to 1,500 nautical miles using auxiliary external fuel tanks. The small twin-jet will have a maximum ground takeoff roll of 2,300 ft. and will clear a 50-ft. obstacle on one engine in 5,200 ft. Gross weight will be 14,350 lb.

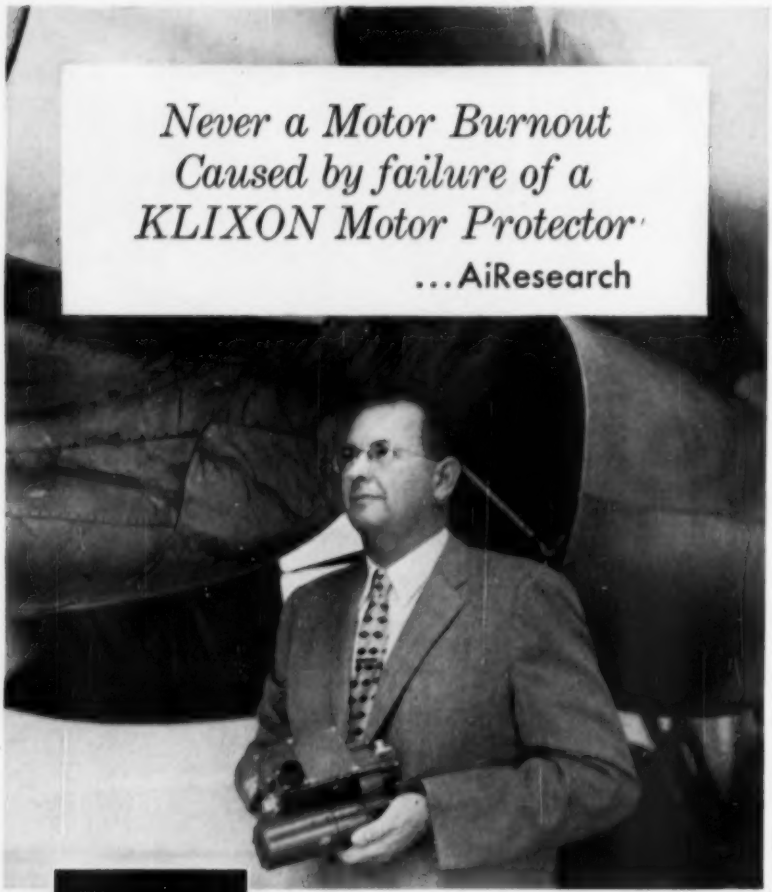
Numerous Entries

At least eight companies, including Lockheed and North American, have indicated interest in the USAF-AMC requirement for the two basic configurations, which was circulated to 28 firms last August (AW Aug. 27, 1956, p. 29). At the time AMC stated that it saw an approximate requirement for 1,000-1,500 of the twin-jet type and 200-300 of the four-jet, procuring the airplanes over a five-to seven-year span.

Navy is also interested in a light jet crew readiness trainer and utility transport for high-speed transportation of personnel. In addition to Lockheed and North American, these other firms are known to be interested in the Air Force and/or Navy programs:

• **Fairchild, with its M-185F** in the four-jet category. Airplane exists in the full-scale mockup stage, and has been ordered in civilian guise by Continental Can and Continental Oil for executive transport use. Initial civilian delivery is expected to be made in 1960. Fairchild plans the high-wing M-185F around four Fairchild J83s in approximately the same power class as the J85, although it may fly the prototype with Westinghouse J34s to speed its development cycle should the J83s not be available when the airframe is ready.

• **Beech has been offering** the Morane Saulnier twin-jet four-seat MS-760 to



Typical of AiResearch electro-mechanical components is this power unit, which Mr. Lytle is holding, used to power the cowl flap actuating system on Douglas DC-7's.

AiResearch Manufacturing Division of The Garrett Corporation, long a leading manufacturer of electro-mechanical components for aircraft, is a major user of KLIXON Inherent Overheat Motor Protectors.

Elvin Lytle, design specialist of AiResearch, talks about KLIXON Protector performance this way:

"To our knowledge, during the past 10 years, AiResearch power units and actuators have never had a burnout caused by failure of KLIXON Motor Protectors."

This Klixon Motor Protector, used so successfully by AiResearch, is but one of a line of single-phase and 3-phase KLIXON Motor Protectors especially designed for aircraft use. In this application, the KLIXON Protector shuts the cowl flap actuator off only when maximum allowable motor winding temperatures are reached — thereafter cycling the motor until its duty is safely completed, or until the cause of overheating is corrected.

Why not write now for information on how to get more out of your aircraft motors with KLIXON Protectors . . . or better still, consult with your aircraft motor supplier, and call for KLIXON protection in your motor specifications.

METALS & CONTROLS CORPORATION

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KLIXON

both services as available-now hardware; it has an option to build the airplane at Wichita under license should it receive enough orders to make production worthwhile. The company has not yet had sufficient interest from civilian buyers to initiate a production program.

• **Cessna is developing** a four-place long-range version of its two-seat twin-jet T-37A USAF trainer, with tiptanks, hoping for a Navy contract that would also pave the way to offering the airplane for civilian business use.

• **Northrop is known** to be interested in the project, but officials are tight-lipped about the status of any design.

• **Convair similarly** has indicated that it is interested in the smaller twin-jet project, but won't discuss progress any further.

• **Temco has projected** a twin-jet high-wing trainer transport design for Navy. The company has discussed the project informally with USAF, although it has not submitted formal proposals to that service. Temco is believed not to have considered commercial applications of its designs, as yet.

• **McDonnell is latest** dark-horse entry in the light jet transport field, although indications are that its project is aimed primarily at the civilian field rather than the USAF-AMC program. The McDonnell project has undergone successful wind-tunnel model testing and is awaiting high-level management decision as to its future.

At the time it circulated its proposal, AMC headquarters estimated that fly-away costs for the twin-jet and four-jet

Improved Visibility

An extra 1,200 sq. in. of transparent area above the cockpit of Garrett Corp.'s corporation DC-3 gives pilot and co-pilot 150% greater visibility than standard configuration. Suggested by crew of the DC-3, three new Lucite panels of about 400 sq. in. were added, the side ones curved to the cabin contour; the top one, which doubles as an escape hatch, nearly flat. Work was done by Garrett's Aviation Service Division, Los Angeles.

USAF Utility Jet Transport

PERFORMANCE REQUIREMENTS

	Twin-Engine/Four Passengers		Four-Engine/8-10 Passengers		
	Desired	Required	Desired	Required	Required (Extended Range)
Combat range[4, 6, 7]	.....	1,500 n.m.	.....	1,500 n.m.	2,200 n.m.[8, 10]
Service ceiling[2]	.....	40,000 ft.	.....	40,000 ft.	.....
Max. cruise alt	45,000 ft.	45,000 ft.	45,000 ft.	45,000 ft.	.....
Service ceiling[1] (one engine)	25,000 ft.	15,000 ft.	25,000 ft.	15,000 ft.	.....
Critical field length[1, 6]	3,500 ft.	5,000 ft.	3,500 ft.	5,000 ft.	8,000 ft.
Landing roll with half fuel[6]	2,500 ft.	2,500 ft.	2,500 ft.	2,500 ft.	.....
Landing speed (110% stall speed)[4]	85 kt.[9]	.....	85 kt.[9]	.....	.....
Cruise speed	M 0.8	M 0.76	M 0.8	M 0.76	.....

[1] Maximum power. [2] Military power. [3] Normal power. [4] MIL-C-5011A fuel reserve and allowances. [5] Mission performance calculated on basis of MIL-C-5011A unless otherwise specified. Baggage allowance of 40 lb. per occupant is calculated in mission allowances. [6] Standard day and sea level altitude. [7] External fuel tanks shall be non-jettisonable. Data presented for a particular mission shall be either with use of external tanks throughout flight, or no external tanks used. [8] A 30-min. endurance at sea level may be used in lieu of MIL-C-5011A allowances. [9] Landing speeds not specified in general design specifications. [10] With 70 kt. headwind.

Direct Operating Costs—1,500 n.m. Trip

Aircraft	Average Ground Speed (no wind)	Enroute Flying Time	Direct Operating Cost/Flying Hour[1]	Trip Cost[2]	Remarks
Beech 18/C-45	130 kt.	11 hr. 30 min.	$45	$518	Two fuel stops
Douglas DC-3/C-47	130 kt.	11 hr. 30 min.	$80	$920	One fuel stop
Douglas DC-4/C-54	160 kt.	9 hr. 20 min.	$155	$1,447	.....
Convair 340/C-131	180 kt.	8 hr. 20 min.	$151	$1,253	.....
UT-X—2 engine	430 kt.*	3 hr. 30 min.	$87[3]	$305	.....
UT-X—4 engine	460 kt.*	3 hr. 15 min.	$165[3]	$536	.....

* Estimated. [1] Includes cost of fuel, oil and maintenance. [2] Estimated ATA formula. [3] All figures rounded off to nearest dollar.
Source: Maj. Gen. J. W. Sessums, Jr. speech before IAS National Summer Meeting.

types should be approximately $200,000 and $400,000, respectively. Purchases would be on an off-the-shelf basis, with the Air Force considering that military support of development programs was inadvisable for these reasons:

USAF research and development dollars should be spent on projects having primary combat mission capability; there is a potential civilian market for the aircraft; estimated costs of the development program were judged by AMC to be within the capability of industry to finance.

Business Aircraft Can Gain Efficiency

Los Angeles—Efficiency of business aircraft can be increased by wide margins utilizing new aerodynamic concepts now available, August Raspet, head, aerophysics department, Mississippi State College, told the summer meeting of the Institute of the Aeronautical Sciences held here recently.

Putting these concepts to work, he said, would give modern designs a third of the drag coefficient, twice the maximum lift coefficient and twice the static thrust of present designs.

Application of only a small degree of geometric boundary layer control to today's business planes would boost performance considerably, he said. Detrimental effect various items produce on aircraft performance does not seem to be too well appreciated by industry, he added, mentioning these factors as offering opportunities for drag reduction: radio antennas, cavities such as unsealed landing gear openings, protuberances, leakage, sharp corners, deicer boots, coarse walkways, etc.

Turbulent skin friction data shows that the turbulent boundary, at a Reynolds number of 10 million, doubles in skin friction for a roughness of 0.02% of chord. Even brazier head rivets exceed this roughness, Raspet noted.

Aspects of the pusher airplane also were analyzed by Raspet. "If we are to attain a maximum in cruising performance we must consider the pusher configuration more seriously. In addition to the elimination of the turbulent slip stream over a large wetted area, the pusher offers a means for recovering the wake energy. This energy may reach a value as high as 15% of the power in the propeller," he declared.

With the pusher propeller there is the possibility of using a duct over the prop to improve thrust for takeoff and climb, an exceedingly important feature for short field planes, Raspet said, since they take off and climb at such low speeds that the ordinary propeller suffers large losses in propulsive efficiency.

For high speed jet executive planes, the propulsion configuration as used in the Caravelle offers the same advantage as the pusher—a clean wing on which boundary layer control may be used most effectively, Raspet said.

Flight to Hawaii Made by Cessna 310

Cessna 310 light twin business plane flew from Oakland, Calif., to Honolulu International Airport, Hawaii, in 13 hr. 51 min. at an average true airspeed of 155 kt.

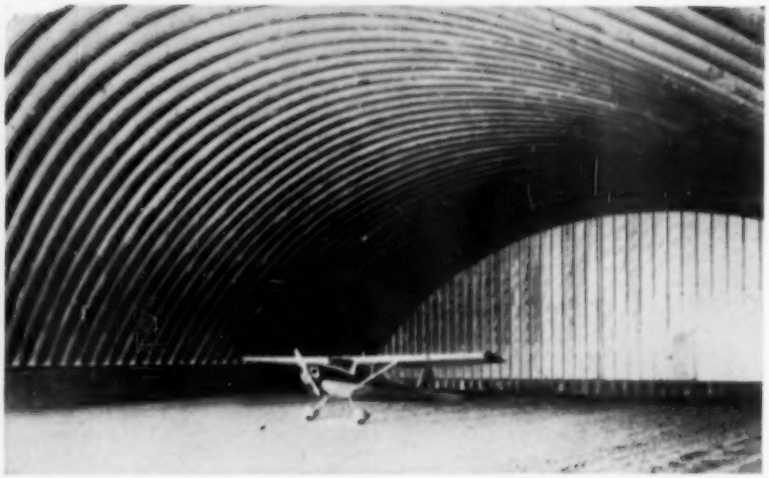
Flight was a project by Murrayair, Ltd., Cessna distributor, which plans to use the 310 for sales, lease and charter work. Takeoff from Oakland was with 337 gal. and the Cessna landed after the 2,442 mi. flight with 100 gal. remaining. Fuel consumption averaged 17.1 gph. at 50% cruise power setting. Takeoff was at 1,000 lb. over normal gross weight.

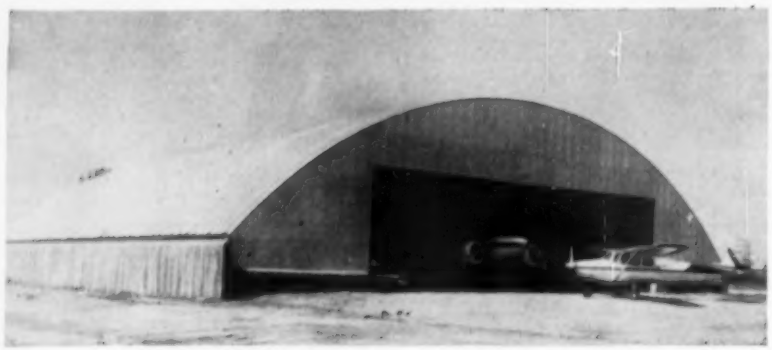
Aside from loss of radio contact, which occurred twice during the flight for about an hour, the trip was described as "routine."

PRIVATE LINES

Howard Super Ventura will be delivered next January to Cluett Peabody Co., Inc., New York, fitted with a Sperry autopilot, Collins communications and navigation equipment, Bendix ADF, Sperry C-4 compass system, Bendix radar and Transvaal HF radio. Cluett Peabody's Super Ventura is the 22d sold by Howard Aero, Inc., San Antonio, Tex.

Record sales response was experienced by a Round Lake, Ill., appliance dealer after he chartered a Piper Cub to drop over three towns promotion literature which carried "lucky numbers" giving holders merchandise and gift certificates. More than 4,500 of the promotion pieces were returned to the





Low-Cost Business Plane Hangar

Trussless 100 ft. x 100 ft. hangar for business aircraft, formed of two-foot wide galvanized steel sheets secured by simple nut and bolt fasteners, was erected by Mt. Vernon Airport Authority, Ill., at cost of $32,080, or $3.20 per sq. ft. including seven-foot reinforced concrete sidewalls and footings. Building can accommodate 15 aircraft, including three twins. Concrete sidewalls are designed to accommodate erection of a second similar hangar planned by the Authority for growing business plane fleet in the Mt. Vernon area. Hangar is manufactured by Wonder Building Corporation of America, Chicago, Ill.

dealer's store in 12 hr. and resulted in initial sales of 14 automatic washers, 5 dryers, 5 refrigerators 2 ranges and a water heater. Plane rental totaled only $30.

U.S. business plane exports in first four months of 1957 were 110% higher in dollar value over the same period last year. Aero Design, Beech, Cessna, Piper and Taylorcraft shipped 440 aircraft valued at $6,922,936 January-April 1957 to 40 foreign countries and Alaska and Puerto Rico, compared to 307 units valued at $3,298,603 in the same period in 1956. In April 120 units valued at $2,073,869 were sent abroad.

Aerial photogrammetry equipment is being supplied by newly formed Rental Division of Gordon Enterprises, N. Hollywood, Calif., camera manufacturer. Equipment available includes cameras, mounts, processing machines, accessories and laboratory equipment.

New line of radome and microwave absorber kits for business and commercial planes has been designed by McMillan Industrial Corp., Ipswich, Mass. Now available are kits for DC-3, B-23, Viscount, Aero Commander and Super Ventura; available in the near future will be similar equipment for Cessna 310, Curtiss C-46 and all Twin Beech models.

C. W. Hewett, managing director of Hewett Aviation, N. Z., plans to evaluate agricultural planes during current visit to U.S. in addition to discussing an agency for National Aircraft spray/dust Stearman.

New Trecker Royal Gull business amphibian agency is Hobart A. H. Cook Associated, N. Y., covering Atlantic Coast. The company is also doing helicopter maintenance, including complete overhauls at its Zahn's (L. I.) Airport base.

Engineers

...cross new frontiers in system electronics at *The Garrett Corporation*

Increased activity in the design and production of system electronics has created openings for engineers in the following areas:

ELECTRONIC AND AIR DATA SYSTEMS Required are men of project engineering capabilities. Also required are development and design engineers with specialized experience in servo-mechanisms, circuit and analog computer design utilizing vacuum tubes, transistors, magnetic amplifiers.

SERVO-MECHANISMS AND ELECTRO-MAGNETICS Complete working knowledge of electro-magnetic theory and familiarity with materials and methods employed in the design of magnetic amplifiers is required.

FLIGHT INSTRUMENTS AND TRANSDUCER DEVELOPMENT Requires engineers capable of analyzing performance during preliminary design and able to prepare proposals and reports.

FLIGHT INSTRUMENTS DESIGN Requires engineers skilled with the drafting and design of light mechanisms for production in which low friction, freedom from vibration effects and compensation of thermo expansion are important.

HIGH FREQUENCY MOTORS, GENERATORS, CONTROLS Requires electrical design engineers with BSEE or equivalent interested in high frequency motors, generators and associated controls.

Send resume of education and experience today to:

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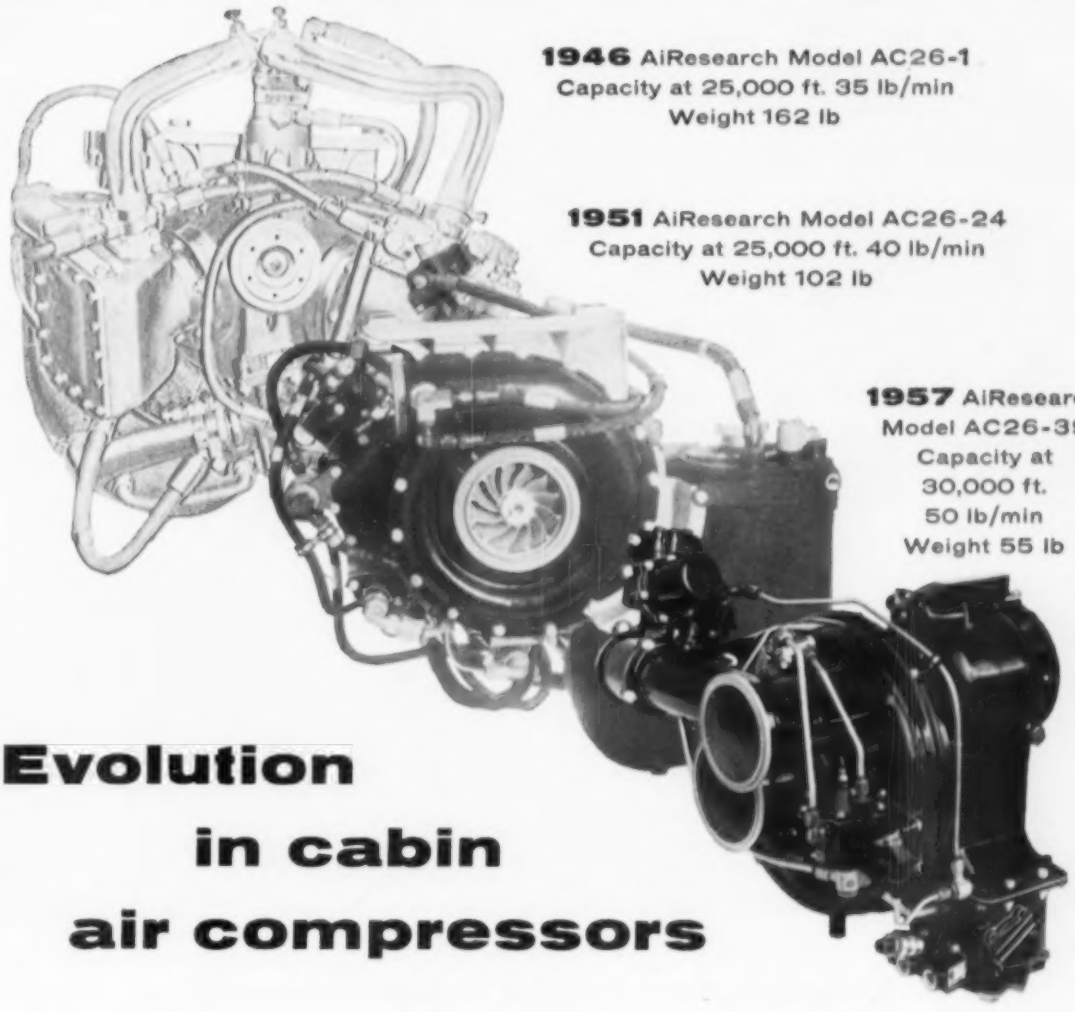

1946 AiResearch Model AC26-1
Capacity at 25,000 ft. 35 lb/min
Weight 162 lb

1951 AiResearch Model AC26-24
Capacity at 25,000 ft. 40 lb/min
Weight 102 lb

1957 AiResearch
Model AC26-39
Capacity at
30,000 ft.
50 lb/min
Weight 55 lb

Evolution in cabin air compressors

New AiResearch unit weighs one-third as much, increases performance by 43%

The performance demands on aircraft cabin air compressors are constantly increasing. Yet weight and space limitation on these pressurization components becomes even more critical. Basic design advancement is the only solution.

AiResearch has achieved this in its new, engine-driven compressor for turboprop aircraft. Compared to earlier models, it increases output by 43% while actually cutting weight to one-third. Dependability and durability are assured by the company's extensive experience in the production of all types of cabin air compressors, including units for the latest jet transports.

Superior performance is further assured by our unmatched experience in developing compatible systems. AiResearch has assumed complete system responsibility in the field of pressurization for many of America's finest present and projected airliners. We invite your inquiries.

Outstanding opportunities for qualified engineers are available now. Write for information.

THE GARRETT CORPORATION

AiResearch Manufacturing Divisions

Los Angeles 45, California . . . Phoenix, Arizona

Designers and manufacturers of aircraft and missile systems and components: REFRIGERATION SYSTEMS • PNEUMATIC VALVES AND CONTROLS • TEMPERATURE CONTROLS
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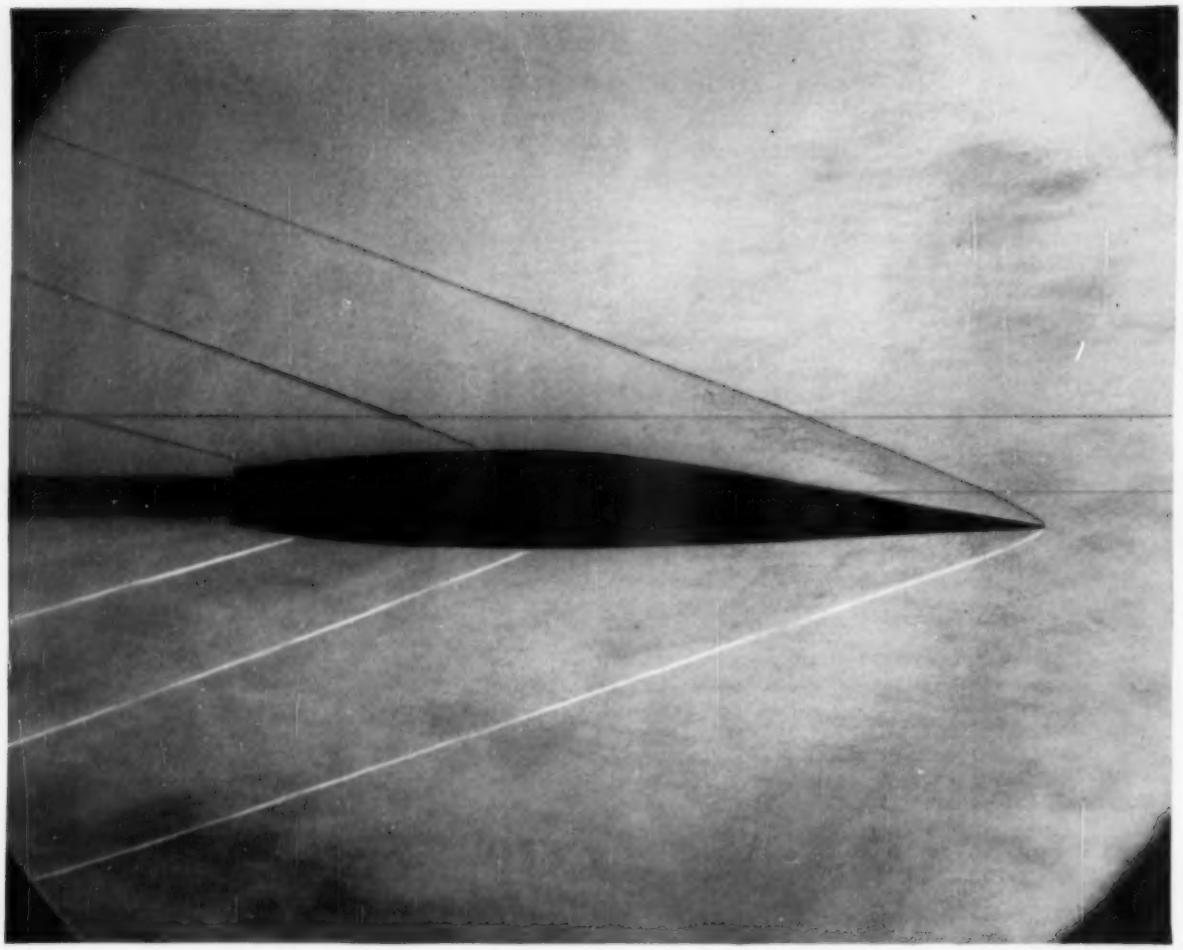

Schlieren photograph of supersonic flight patterns in wind tunnel.

The formula that gives America its supersonic strength

Our future security depends on our ability to hold command of the supersonic front. Technology must advance beyond the present limits of human understanding. Aircraft must fly at speeds far beyond what we now call supersonic.

To this task North American brings its vast experience in supersonic aircraft—greatest in the Free World. Advanced concepts are being developed—as revolutionary tomorrow as these North American benchmarks of today:

The F-100 Super Sabre. In 1953, the first production-line F-100 exceeded the speed of sound on its first flight. In 1954—two years before any other supersonic airplane became operational—the Air Force had F-100s in wing strength. There is still no Air Force operational supersonic airplane that can match the reliability, strength, and performance of the F-100. No other can match its tactical and combat versatility, or its endurance—dramatically demonstrated by recent record-breaking nonstop flights from London to Los Angeles, Los Angeles to New York, and New York to Paris.

The X-10 Test Missile proved out the aerodynamic design and flight-control systems of the Navaho intercontinental guided missile. The supersonic Navaho is American's most advanced strategic weapon—and the closest to production.

The X-15 Rocket Plane, now in production, will carry man higher and faster than ever before. It is setting the pattern for the Air Force of tomorrow.

From the P-51 through the F-86 and the F-100, North American has designed planes with growth potential to use more power as it became available. It has translated this ideal performance into wing-strength reality—accurately, rapidly, and at lowest possible cost.

The formula for supersonic strength in the future is supersonic experience today. North American has it.

NORTH AMERICAN AVIATION, INC.

Los Angeles, Fresno, Canoga Park, Downey, California; Columbus, Ohio; Neosho, Missouri.

NORTH AMERICAN HAS BUILT MORE SUPERSONIC AIRCRAFT THAN ALL OTHER COMPANIES COMBINED

Beech Travel Air Can Cruise at 200 mph.

Wichita, Kans.—First detailed official performance and specifications data revealed on the new four-place light twin Beech Model 95 Travel Air show that this utility plane will have a maximum cruise speed of 200 mph. at 7,500 ft. on 75% power.

Initial deliveries of the new business plane will begin this fall. Cross-country demonstration tour is expected soon following completion of Civil Aeronautics Administration certification requirements (AW June 10, p. 40).

Travel Air on June 18 received its type and production certificate from CAA—becoming the first completely new Beech airplane to be certificated under CAA's delegation option authority procedure, under which the manufacturer has responsibility for approving all engineering data and testing.

Structural tests were at 115% or more of CAA strength requirements. Flight test phase of the certification program were completed in 60 days. Prototype made its first flight Aug. 6, 1956.

New Beech light twin received its first cross-country workout when it was flown from the factory to Ft. Rucker, Ala., for demonstration to the Army. During the 900-mi. flight, which included numbers of detours because of heavy weather, the airplane averaged 200 mph. ground speed using 65% power and carrying two people.

Some 550-600 mi. of the trip was between and around heavy thunderstorm activity, with altitudes ranging from fairly low to over 10,000 ft. between and above cloud. Aboard were Beech Vice President-General Manager John P. Gaty and Engineering Test Pilot Steve Tuttle.

COWL FLAPS replace exhaust augmentor cooling system on latest version of Travel Air.

During the demonstration at Ft. Rucker, Tuttle got the Travel Air off the base 1,300-ft. runway before he reached the 150-yd. marker and landed and turned off the strip before reaching this distance. This was done with only the pilot aboard and about 50% fuel.

To demonstrate the airplane's acrobatic ability, Tuttle flew it down the runway at about 30-ft. altitude at approximately 200 mph., feathered one propeller and rolled the airplane toward the dead engine.

The test pilot contends that the Travel Air is clean enough so that he could safely take it over a runway at 200 mph., feather both propellers, pull up and turn 360 deg. and make a normal approach and landing with dead engines at approximately the same spot where he had feathered both propellers.

An observer has commented that soundproofing in the new airplane is so effective that at 200 mph. cruise speed, the loudest sound inside the cabin is that produced by hissing produced by the air vent in the ceiling. Beech is investigating means of reducing this noise level to even lower values.

Travel Air is powered by the new Lycoming O360-A1A four-cylinder opposed engine delivering 180 hp. at 2,700 rpm. The O360 weighs 282 lb. including starter and generator and operates on 91/96 octane fuel. Engine measures 24.68 in. high x 33.37 in. wide x 29.56 in. long. Delco Remy starter, generator and voltage regulator are standard equipment, diaphragm fuel pump drive, vacuum pump drive and constant speed propeller governor drive are optional. Engine's features include salt-cooled rotator-type valves.

Beech 95 Travel Air

PERFORMANCE AND SPECIFICATIONS

Maximum cruise speed @ 2,450 rpm.	200 mph. @ 7,500 ft.
Maximum cruise speed @ 2,350 rpm.	191 mph @ 11,500 ft.
Top speed @ sea level @ 2,700 rpm.	208 mph.
Rate of climb @ sea level, two engines	1,350 fpm.
Rate of climb @ sea level, one engine	250 fpm.
Service ceiling @ gross weight, two engines	19,000 ft.
Service ceiling @ gross weight, one engine	6,200 ft.
Absolute ceiling @ gross weight, two engines	20,900 ft.
Absolute ceiling @ gross weight, one engine	8,000 ft.
Stall speed, power off, 33-deg. flaps, gear down	68 mph.
Maximum range @ 164 mph., on 110 gal.	1,400 mi.
Endurance	8.73 hr.
Takeoff distance, maximum performance, no wind	850 ft.
Takeoff distance over 50 ft. obstacle	1,050 ft.
Landing distance, maximum performance, no wind	979 ft.
Landing distance over 50 ft. obstacle	1,449 ft.
Standard tanks usable fuel capacity	84 gal.
Maximum usable fuel with optional auxiliary wing tanks	110 gal.
Oil capacity	16 qt.
Maximum baggage capacity, rear	270 lb.
Maximum baggage capacity, less equipment, front	270 lb.
Gross weight	4,000 lb.
Empty weight	2,580 lb.
Payload	916 lb.
Wing span	37 ft. 10 in.
Length	25 ft. 4 in.
Height	9 ft. 6 in.
Wing area	193.8 sq ft.
Wing loading, gross weight	21.6 lb./sq. ft.
Power loading, gross weight	11.1 lb./hp.
Cabin length	6 ft. 11 in.
Cabin width	3 ft. 6 in.
Cabin height	4 ft. 2 in.
Main gear tires	6.50 x 8
Nose gear tire	5.00 x 5
Battery	24 v., 17 amp. hr.
Landing gear vertical descent component	600 fpm. plus
Power plant	2 Lycoming O360-A1A @ 180 hp. @ 2,700 rpm.
Propeller	2 Hartzell 72-in. diameter full-feathering, hydraulically controlled variable pitch

AMC Contracts

Wright-Patterson AFB, Ohio—Following is a list of USAF contracts as released by the Air Materiel Command:

Allison Division, General Motors Corp., Indianapolis, $12,337,920 for J71 turbojet engines, technical data and bill of materials. J71, rated at 10,000 lb. thrust, powers the Douglas B-66.

Bendix Radio Division, Bendix Aviation Corp., Baltimore, $2,223,751 for radar sets.

General Electric Co., 40 Federal St., West Lynn, Mass., transmitter, rate of flow, type MB-2 used on C-132A and C-133A aircraft, (PR 603635), $126,121.

Fairchild Camera & Instrument Corp., Robbins Lane, Syosset, L. I., N. Y., items of spare parts for T-11 and K series aerial cameras, (PR 736400, 736400-1, 736400-2, 736400-3), $42,983.

Westinghouse Electric Corp., 32 N. Main St., Dayton, Ohio, generators, AC, aircraft 40 KVA, P/N A50J207 for F-102 and C-130 aircraft, panels, protectic, AC electrical, P/N 40A1735-2 for F-102 and C-130 aircraft, regulators, voltage, AC generators, P/N A40A1704 for F-102 and C-130 aircraft, panels, control, generators, AF type G-1 for F-102 and C-130 aircraft (PRs 694375, 694383, and 729473Q), $303,777.

Kollsman Instrument Corp., Standard Coil Products Co., Inc., 80-08 45th St., Elmhurst, N. Y., type C-2A true airspeed and machnumber computer for B-52 aircraft, (PR PE-603555 and SA-692148), $552,409.

General Electric Co., Erie, Pa., generators, GE model 2CM85D1B (Inst) for C-130A aircraft, generators, (ARTC) for C-130A aircraft, generators, (spares) for C-130A aircraft, spare parts and data for C-130A aircraft, PR PE694373Q), $458,336.

Red Bank Div., Bendix Aviation Corp., Eatontown, N. J., generators, aircraft engine driven, 30 volt for H34A, (PR PE-694372Q), $60,294.

Jack & Heintz, Inc., 17600 Broadway, Cleveland, Ohio, DC generators, 300 amp., type MA-8 for C-124 aircraft, adapter, accessory mounting, generators, DC, 300 amp, type MA-8 for C-124 aircraft, spare parts and data for C-125 aircraft, (PR SA-72099Q), $991,311.

Crosley Div., AVCO Manufacturing Corp., 2630 Glendale-Milford Rd., Cincinnati 15, Ohio, type MD-9 fire control system, bomber flexible tail defense spare components and parts, (PR 604386), $2,500,000.

Guardian Electric Manufacturing Co., 1621 West Walnut St., Chicago, Ill., tester-in flight control type 19B aircraft, (PR 604303-PE), $115,027.

Eclipse-Pioneer Div., Bendix Aviation Corp., Teterboro, N. J., computer, central air data, used on F101 and F105 aircraft, converter, central air data, used on F101 and F105 aircraft, compensator, central air data, used on F101 and F105 aircraft, (PRs 603619 and 603587), $6,736,102.

Radio Corp. of America, Front & Cooper St., Camden 2, N. J., radio set control C-455 for radio set AN/ARM-21, 1004 ea., (PRs 628748 and 670890), $25,600.

The Morse Instrument Co., 21 Clinton St., Hudson, Ohio, B-5A photo processing machine, 501 ea., B-5A photo processing machine, 247 ea., drawing for item #1, 1 set, (PR MO-735869), (MIPR R57/21/G6/C,F/12NSF and IFB 33-600-57-64), $209,872.

Airborne Accessories Corp., 1414 Chestnut Ave., Hillsides, N. J., actuator assy. to support F86 acft, data to support F86 acft, (PR SA-639653), $113,237.

The Garrett Corp., AiResearch Manufacturing Co. Div., 9851-9951 Sepulveda Blvd., Los Angeles 45, Calif., actuator assy to support F86 acft, program and data for F86 acft, (PR S-639651), $92,740.

The General Tire & Rubber Co., 1708 Englewood Ave., Akron, Ohio, nose, wheel assys, 18x5/5, (AIW-1001) for F-101B, F-104A, F-104B, and RF-104A aircraft, (IFB 33-600-57-75 and PR 564282), $64,002.

International Telephone & Telegraph Corp., Federal Telephone & Radio Co., Div., 15191 Bledsoe St., San Fernando, Calif., power supplies, metallic rectification for B-52, KC-135 acft, (PR 694444 and 694459), $673,017.

Red Bank Div., Bendix Aviation Corp., Eatontown, N. J., generators, 20 KVA, A. C., 3 phase, P/N 28B23-3-A for F-104 acft, (Inst), for F-104 aircraft, generators, (spares) for F-104 aircraft, panels, control, P/N 34B3-3A (Inst) for F-104 aircraft, panels, (spares), regulators, voltage, P/N 20B9-1-A (Inst) for F-104 acft, (PR PE-694371), $3,275,220.

The Tumpane Co., Inc., USAFDIER Storage Site No. 6, Marietta, Ga., services; in connection with maintenance and operation of machine tool storage site, (PRs 631105 and 673216), $112,443.

Bell Aircraft Corp., Hurst, Texas, Model H-13J Helicopter for the USAF, Winterization Kit (PE PH671014), $123,600.

Philips Petroleum Co., McGregor, Tex. Facilities for JATO Production and development, (PR 673182), $442,000.

General Dynamics Corp., Convair Div., San Diego, Calif., F-106A Aircraft, spare parts and related items, (PR PH-633982) PD 631052 and PH 583088), $20,634,869.

Douglas Aircraft Co., Inc. Santa Monica, Calif. Facilities in support of the WS-316A Program. (PR 603778), $29,625.

Utica-Bend Corp., Utica, Mich. Acquisition, rehabilitation and installation of machinery and equipment for overhaul of J-47 engines. (PR 749752), $1,300,000.

General Dynamics Corp., Convair Div., San Diego, Calif. F-106B Aircraft, spare parts ground support and data, (PR PH-631051), $1,000,000.

Boeing Airplane Co., Seattle, Wash. Facilities for the production of B-52 and KC-135 Aircraft, (PR 749768), $840,000.

General Motors Corp., Allison Div. Aeroproducts Operations, Vandalia, Ohio. Facilities for the production of propellers for C-130 aircraft. (PR 673062), $750,000.

Collins Radio Co., Cedar Rapids, Iowa.

No Asthma in a GLOBEMASTER!

When a Douglas C-124 Globemaster coughs too hard—when the engines backfire, as all engines do—the impact on the carburetor air intake duct is terrific. When these ducts are made of laminated fiberglass plastic, something must be added to keep them from delaminating from that impact, for pieces coming loose will indeed cause asthma, once the plane's movement brings a rush of air through the duct.

Materials and Process Engineers of Douglas Aircraft Company, Long Beach Division, working with Stoner Rubber Company, developed a liner of Silicone Modified Rubber. When this unique, tough rubber was bonded in place, no amount of backfire reduced the utility of the duct. The Globemaster could still breathe freely.

Your investigation of Silicone Modified Rubber, particularly when used in conjunction with plastic ducting, may solve some of your vexing problems.

In addition to increasing impact resistance, .020" wall phenolic ducting lined with .015 SMR shows zero leakage at continuous 50 p.s.i. This can be done in a one-stage manufacturing operation, with simultaneous cure and bonding of rubber and plastic.

STONER RUBBER COMPANY, INC.
ANAHEIM, CALIFORNIA

THE FINEST IN ENGINEERED RUBBER PRODUCTS

Course indicator, Collins servo amplifier, Collins components or flight director system for use on SAC C97 Aircraft, (PR OC-730803), $11,104.

Sperry Gyroscope Co., Div. Sperry Rand Corp., Great Neck, N. Y. Receiver Transmitter, Antenna, Indicator, Azimuth and Range (PR-670888), $6,471,402.

American Air Export and Import Co., P.O. Box 875, International Airport Branch, Miami, Fla., Domestic Air Transportation Services (PR TD-7-S-1001), $349,381. Northeast Airlines, Inc., Logan International Airport, Boston 28, Mass., CRAF Group A modification aircraft in-production, (PR 622606), $44,220.

Eastern Air Lines, Inc. 10 Rockefeller Plaza; New York 20, N. Y. CRAF Group A modification on DC-7B Aircraft while-in-production. (PR PM-7-S-5010), $90,915. Overseas National Airways, Inc., P.O. Box 2396, Oakland International Airport, Oakland, Calif., AIR Transportation services, Travis AFB, Calif., Tokyo, Japan and return via Honolulu and Wake Island, (PR PM-7-S-5001), $729,964.

Cathedral Films, 140 North Hollywood Way, Burbank, Calif., 16 mm color, Morton picture prints, (PR 669796), $26,500.

United Air Lines, Inc., 5959 Cicero Ave., Chicago 38, Ill., GRAB Group A APX-25 Modification. GRAF Group A 618S-1 modification (PR 72635), $55,018.

The Flying Tiger Line, Inc., Lockheed Air Terminal, Burbank, Calif., Additional Group B Requirements, Storage of Equipment, (PR 672631), $42,542.

Trans World Airlines, Inc., 10 Richards Road, Kansas City 5, Mo., Modification of in-production commercial aircraft for CRAF, (PR PM-7-S-5027), $33,250.

Pan American World Airways, Inc., 135 East 42nd St., New York, N. Y. Senior Lodger services in connection with the Civil Reserve Air Fleet, Program, Erection of the CRAF Facility, (PR 622607), $68,058.

Hayes Mfg. Corp., Hayes Aircraft Corp., Box 2287, Birmingham, Ala., Increase funds allotted to L/C S/ #5, KB-50 modification, (PR 8169), $200,000.

Kearney and Trecker Corp., 6784 West National Road, Milwaukee 14, Wis., Increase items 1a and 2 to include dealers & services, milling machines, (PR 749916), $253,898.

Kearney and Trecker Corp., 6784 West National Road, Mil. 14, Wis., increase items 1 and 2 to include dealers services knee type milling machine, (PR 749916), $75,182.

Kearney and Trecker Corp., 6784 W. National Rd., Mil. 14, Wis., Increase item 1 to include dealers services milling machine, (PR 749916), $153,045.

Consolidated Diesel Electric Corp., Ludlow and Canal Sts., Stamford, Conn., Training parts, tools, and equipment multi-purpose servicing vehicle (PR 672027), $100,000.

Republic Aviation Corp., Farmingdale, Long Island, N. Y. Additional Services in

Boeing Test Chamber

New test chamber being installed at its Seattle plant will permit Boeing to test entire airplane systems at temperatures ranging from —85 to 1,200F, and at simulated altitudes up to 120,000 ft. Big steel tank is 19 ft. in diameter and 35 ft. long.

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connection with the F-84 Aircraft. (PR 671686-1, and 671687-1), $48,000.

International Airport, Miami 48, Fla., Domestic Air Transportation Services. (PR 709102), $356,723.

Machinery Overhaul Co., Inc., USAFDIER S.E.#2 P.O. Box 187, Palmdale, Calif., For operation and maintenance of USAFDIER S.S. #2 (PR 604690 and 180757), $716,566.

Royal Jet, Inc., 1024 Westminster Ave., Alhambra, Calif., (450 gal. jettisonable fuel) tanks for the F-101 Aircraft. (PR 672025), $354,400.

W. L. Maxson Corp., 460 W. 34th St., N. Y. Royalty payments for License Rights, (PR 670733), $70275.

Robertsand Schaefer Co., 120 N. Wells St., Chicago 6, Ill., Architect engineering services for air conditioning of existing building and airconditioning of hazardous test building. (PR 219891), $22,242.

United States Testing Co., 1415 Park Ave., Hoboken, N. J. Non-research and development tests on propellers and propeller components. (PR 7358, 7359, 7360, 7361, and 7362), $27,290.

The Goodyear Tire and Rubber Co., Inc., 1144 Market St., Akron 16, Ohio, Wheel Assembly, 20.00-20 Brake Assembly. For C-130A Aircraft (PR PE-564241), $533,962.

Bendix Aviation Corp., Pioneer-Central Div., Davenport, Iowa, Transmitter, Rate of Flow, fuel, type MA-1 used on F105B and F105C Aircraft, (PR 603565), $123,661.

American Machine and Metals, Inc., U. S. Gauge Div., Sellerville, Pa. Indicators rate of flow, fuel types MA-6 and MA-2, used on F105A, F106B, F105B, and F101B Aircraft, (PR 603566 and 708063), $61,364.

Lambert Engineering Co., 918 S. Royle Ave., St. Louis, Mo., modification kits for types B-4 photoflash ejector, 154 ea. modification kits for type A-6 photoflash ejector, 210 ea., (PR MO-736423 and MO-736424), $59,629.

Safe Flight Instrument Corp., 4 Water St., White Plains, N. Y. Vibrator-Instrument panel. (For B-47 Aircraft), (PR SA-639659 and SA-639659-1), $142,470.

General Electric Co., 40 Federal St., West Lynn, Mass., Transmitter, Rate of flow, fuel, type MB-2 used on KC-135A, (PR 603717), $804,637.

General Electric Co., 40 Federal St., West Lynn, Mass., indicator, rate of flow, fuel, type MA-7 and MA-8, used on B-52D, C-132A and C-133A acft, (PR 603572, 603572-1, 708093 and 708093-1), $745,760.

American Automatic Typewriter Co., 2323 N. Pulaski Rd., Chicago, Ill., drier, photo film type EL-2, maintenance and engineering data, (PR-736603), $134,558.

Continental Aviation and Engineering Corp., 12700 Kercheval Ave., Detroit, Mich., J69-T-9 engines, J69-T-19A engines, maintenance and engineering data, engineering changes ad MT & TE, (PR 604747, 604714, MIPR-R56-6270-245 aer ad amendments 1 and 2), $2,761,774.

Schroeder Plant

This new plant, for Sept. 1 occupancy, will be leased by Schroeder Manufacturing Inc. to permit sales volume increase from current $600,000 to $5-million annually. Building covers 25,000 sq. ft. and will house 200 employes, including an expanded engineering department. Schroeder Manufacturing, which makes valves and other accessories for the aircraft industry, was recently bought by Frederick W. Richmond of New York. Plant is located in the Rancho San Pedro industrial area of Los Angeles.

Lear, Inc., Grand Rapids Div., 110 Ionia Ave., N.W., Grand Rapids 2, Mich., actuator assy to support F-84 program, data. (PR SA-715401), $95,343.

J & H Smith Co., Little Britain Rd., Newburgh, N. Y., antenna, half-wave dipole, type AT-4B/ARN-1 used with ARN-7, radio directional finder. (PR MD-688213 and amendment 1), $41,132.

USAF Contracts

Following is a list of unclassified contracts of $25,000 and over as released by Air Force Contracting Offices:

MOBILE AMA, Brookley AFB, Ala.

Erie Mfg. Co., 4000 S. 13th St., Milwaukee, Wis., cylinder assys, maintenance and overhaul parts for types H2, MD-1 and MD-2, 13 items, (AF 01 (601)20223, class 03K), $70,487.

Erie Mfg. Co., 4000 S. 13th St., Milwaukee, Wis., cylinder assy emergency oxygen type MD-1 IAW AF dgw 54C3721, 16864 ea., (AF 01 (601)20227, class 03K), $296,806.

Great Lakes Rubber Corp., 33 Scott St., Hamburg, N. Y., tubing oxygen mask to regulator IAW spec MIL-T-7138 and Amend #4 dtd 6 June 56 and an dwg AN6003 dtd 23 May 55, 13860 ea., (AF 01 (60)20250, class 03K), $62,508.

R. E. Darling Co., Inc., 4858 Cordell Ave., Bethesda 14, Md., tubing oxygen mask to regulator IAW spec MIL-T-7138 & amend #4 dtd 6 June 56 and AN dwg AN6003 dtd 13 May 55, (AF 01 (601)20249, class 03K).

Lord Mfg. Co., 1635 W. 12th St., Erie 6, Pa., bushing assy-engine shock support mount, appl, C47 series, C53 series, 6000 ea., bushing engine mount appl., L19A, B, 9650 ea., bushing engine mt appl L19A, B, 370 ea., bushing assy eng mtg 2.62 in OD 1.07 in thk, appl, L23A, 4470 ea., mounting engine cowl flap appl T29A, B, 500 ea., mounting engine cowl botom appl T29A, B, 1600 ea., mounting tube form 1.725 in O-A lgth 1.2450 in max OD .3135 in. max ID appl C119G, 13000 ea., mount engine suspension 3.748 to 3.765 in OD 1.261 to 1.271 in. ID 1,600 in. thk appl H23, 280 ea., mounting engine cowl side appl T29A, B, 600 ea., insulator-vibration, this is a component of 1AGB-55036-1 link assy ring cowl attaching appl. SA16A acft, 3380 ea., protector dynafocal suspension appl MR26SA, 2600 ea., washer countersunk appl MR27B-SA, 700 ea., washer flat appl MR27B-SA, 17400 ea., washer star lock appl MR27B-SA, 14000 ea., bolt intr wrenching steel bevel HD 3-4 in. dia 7-16 in. H of HD socket recess .315 in. WD between flats thd .437 in. —20 NF 3.736 in. lgth DRL for cotter pin .160 in. hole dia. 3.46 in. from HD 3.75 in. lg P-O P-N MR27D-SA U-O P-N R1300-3, appl H19E, 2500 ea., core assy-engine mount appl NR MR27D-SA suspension sub assy, 1219 ea., washer dynafocal suspension appl MR 36FSA MR36H-SA, 560 ea., bolt-housing engine mount appl MR40D1SA MR40H-SA, 27800 ea., washer engine mount appl MR40-

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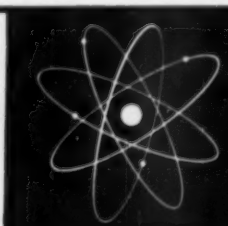

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SYSTEMS ANALYSTS (engineering and mathematics)
CIRCUITRY DESIGN ENGINEERS
SERVO DESIGN ENGINEERS
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Navy Contracts

Following is a list of unclassified contracts of $25,000 and over as released by Navy Contracting Offices:

AVIATION SUPPLY OFFICE, 700 Robbins Ave., Philadelphia 11, Pa.

Telephonics Corp., Park Ave., Huntington, L. I., N. Y., headset assys, (IFB-383-1164-57), 22900 ea., $244,259.

The Goodyear Tire & Rubber Co., 1144 E. Market St., Akron 16, Ohio, brake assys, (383/210-94/55, 383/2110-1473/53), various, $249,561.

Holley Carburetor Co., 11955 E. Nine Mile Rd., Van Dyke, Mich., services & repair parts for fuel controls, (MIPR 41-608-7-93D-2305), various, $184,441.

North American Aviation, Inc., Columbus Div., 4300 E. Fifth Ave., Columbus 16, Ohio, fitting, panel and aspirator assys, (383/2110-1711 A 3/4/53), various, $68,177.

The Goodyear Tire & Rubber Co., Inc., 1144 E. Market St., Akron 16, Ohio, brake & wheel assys, (383/2110-1501/53), various, $88,443.

AiResearch Mfg. Co., A Div. of the Garrett Corp., 9851-9951 Sepulveda Blvd., Los Angeles 45, Calif., regulator, thermostat and sparator assys (383/2110-1560 x 2/1/53), various, $86,809.

NAVY DEPT. Bureau of Aeronautics, Washington 25, D. C.

Sperry Rand Corp., (Sperry Gyroscope Co., Div.) Great Neck, L. I., N. Y. Aerodynamic study program noas 57-449-c (AD-31-3599-57) $129,590.

The Kaman Aircraft Corp., Bloomfield, Conn., Helicopters, Model HOK-1 spare parts and special support Equipment NOas 57-439-L/T (serial No. 600-57) $4,430,008.

Chance Vought Aircraft, Inc., P. O. Box 5907, Dallas, Tex., transicontainers and trailer transports, NOas 56-931-f (MA-47-5143-56), $124,163.

Roylyn, Inc., 1706 Standard Ave., Glendale 1, Calif., acquisition, rehabilitation and installation of machine tools, NOas 57-025-c (IP-3-4965-57), $200,126.

Babcock Radio Engineering, Inc., 7942 Woodley Ave., Van Nuys, Calif., electronic equipment, NOas 57-149-f (AV-31-2592-57), $113,499.

Specialties, Inc., Skunks Misery Rd., Syosset, N. Y., transmitters, indicators, approach light sets, cockpit lights and flap compensators, NOas 57-214-c (PD-42-1316-56), $347,905.

Collins Radio Co., Cedar Rapids, Iowa, AN/ARC-38 and AN/ARR-41 electronic equipment, NOas 57-438-r (PD-32-879-57), $16,600,352.

General Motors Corp. (Allison Div.-Aeroproducts Operations), Municipal Airport, Dayton 1, Ohio, modification of AD8664FN propeller assy, NOas 56-667-r (PD-51-3103-52), $3,333,792.

NAVY PURCHASING OFFICE, Washington, D. C., 4th & Independence Ave., S.W., Washington, D. C.

Benrus Watch Co., Inc., Waterbury, Conn., launchers, guided missile and pylons, Aero 3A, (N600(A 44025), 4080 ea., $1,920,-840.

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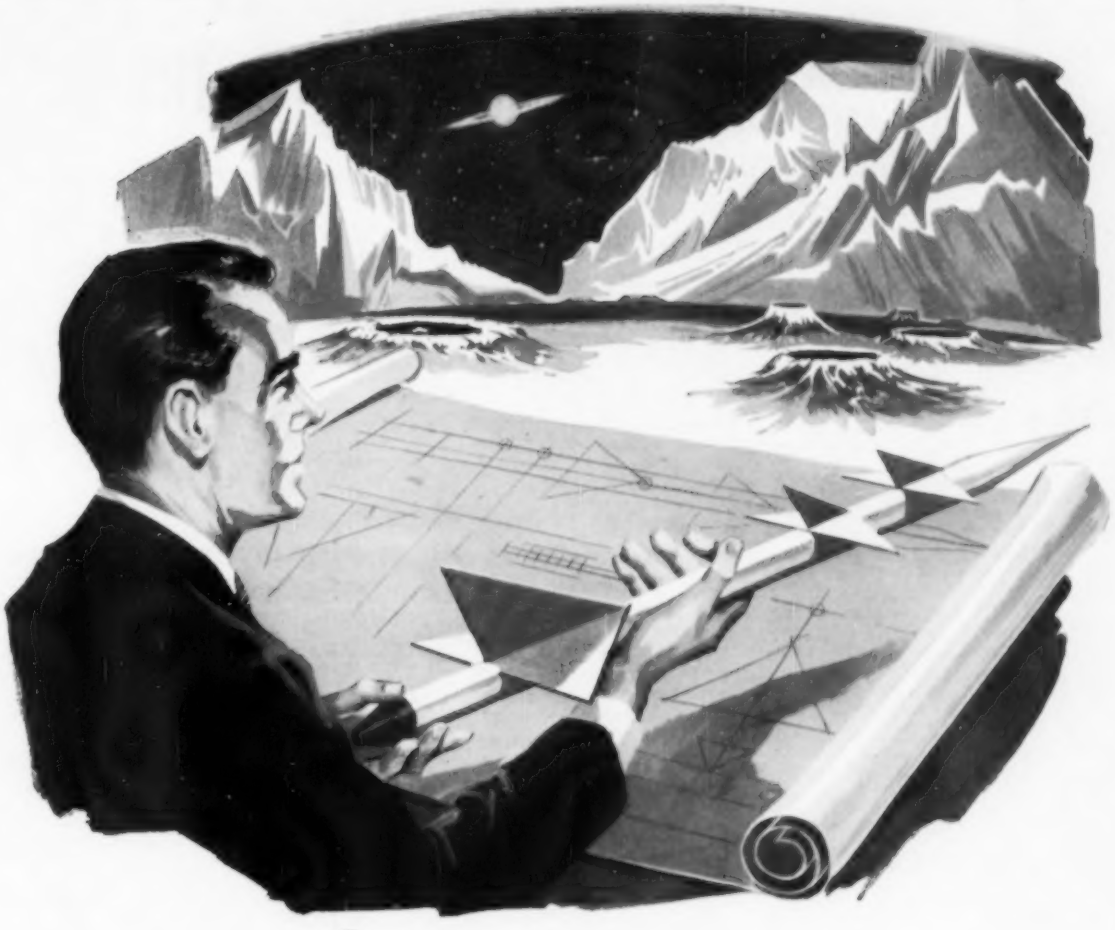

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TEST ENGINEER
Performs and assists in testing complex inertial equipment and in particular the inertial platform. Must be capable in directing the duties of test technicians and maintaining rigid production schedules. Must have experience in gyroscopic and basic gyroscopic test techniques.

TEST ENGINEER
Performs and assists in testing activities of complex computers for fire control and guidance systems. Must be capable of directing the duties of test technicians and maintaining rigid production schedules. Experience should include a background in basic test techniques in the above field.

OPERATIONAL EVALUATION ENGINEER
Conduct operational checks on electronic and electromechanical systems, locate and evaluate deficiencies and report on specific phases of the environmental test program.

DEVELOPMENT ENGINEER — CIRCUITRY
Research and development engineering work in radar pulse circuits, sweep and indicator circuits, intermediate frequency amplifier circuits, and feed back amplifiers. Must have post graduate experience in circuit development engineering with applications in both radar and countermeasures fields.

PRODUCT ENGINEER
Initiate, compile and maintain design standards on electrical, electronic and mechanical design subjects pertinent to fire control equipment and inertial guidance components. Must have considerable responsible experience on product design standards covering areas indicated in job studies.

PROJECT ENGINEER — AIRBORNE EQUIPMENT
Project engineering of computers, pro and anti submarine fire control equipment, airborne navigation plotting equipment and similar equipment. Preparation and proposals on equipment of such types.

RELIABILITY ENGINEER
Develop methods for evaluation of accuracy, reliability and operational suitability of missile guidance systems.

OPERATIONAL EVALUATION ENGINEER
Perform engineering studies and analysis of techniques for evaluating performance of missile guidance systems and its components including gyros, accelerometers, digital computers.

TEST SPECIFICATION AND PROCEDURES ENGINEER
Assess adequacy of test procedures, methods and test equipment in the major assemblies and complete fire control systems. Revise existing test procedures so that automated procedures and automated equipment may be utilized.

PROJECT ENGINEER — AIRBORNE EQUIPMENT
Guide and assist engineers in technical problems in field of electrical and electronic design, servo systems, missile guidance systems. Responsible for major product improvement program and test programs. Provide technical liaison with quality control. Heavy servo background desired.

GROUND EQUIPMENT ENGINEER
High degree of technical and administrative responsibility on complex projects involving the design and development of production test and field test equipment for gyroscopic systems and digital computers.

PRODUCTION TEST EQUIPMENT DESIGN ENGINEER
To administer and technically direct the design, development and manufacture of test equipment for production use in the manufacture, inspection and test of highly complex electronic equipment.

SYSTEMS EVALUATION (MISSILE GUIDANCE)
Perform functional engineering studies and design of inertial guidance systems, determine system and component requirements and performance, conduct system and component dynamic studies and simulation, perform error analysis.

GYRO DEVELOPMENT ENGINEER
Develop precision gyro systems including mechanical problems such as lubrication, temperature controls, hydrostatics, and vibration and electronic work on accelerometers, amplifiers, torquing circuits and electrical pickups.

PLATFORM ENGINEER
Conduct investigation of a theoretical nature relating to gyros or inertial platforms including design of closed loop control equipment pertaining to the above.

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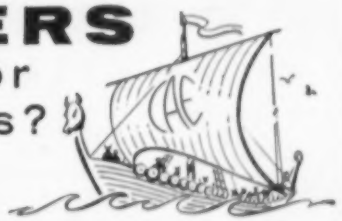

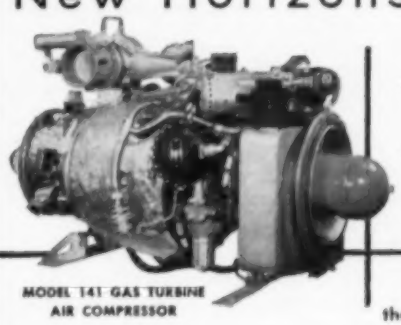

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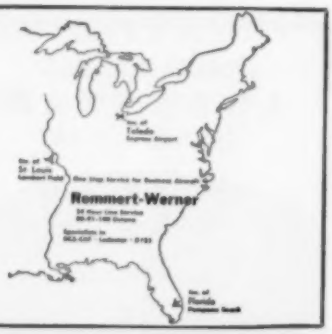

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LETTERS

Bravo for Jobshopper

I feel that I must comment on the letter published in your May 20 issue (p. 158) under the caption "Surplus or Shortage?" from "A (Happy) Jobshopper."

I say, Bravo! And, Amen! Here, at last, is one of the most intelligent and forthright explanations yet put forward in your columns re the so-called engineer shortage.

That writer really knows what he's talking about. Amidst all the various half-truths, propaganda, immature and inexperienced statements, etc. which this subject has brought forth, *here* is a comprehensive, honest appraisal that "really lays the facts on the line."

I have been a student of aviation since 1927, and have been actively employed in the airplane business since my graduation from engineering college in June 1939.

A DISILLUSIONED ENGINEER

Can Be Replaced

In reply to the "A (Happy) Jobshopper," (AW May 20, p. 158), let me say this: The scientist who denies himself culture can (and should) be replaced with two tubes and a twenty-cent resistor.

SCIENTIST
Altadena, Calif.

Rights to Airspace

Your excellent editorial "Are We Wasting Precious Airspace?", AVIATION WEEK, May 27 (p. 21), deserves elaboration.

Is not this "arrogance and disregard for the overall public good that has been exhibited by key military personnel" in their "gobbling of vast airspaces," typical of the "dictatorial bureaucracy" that has replaced our Constitutional Government?

When we realize that our One World Internationalists have succeeded in obtaining:

Government ownership of 50% of the land area of this nation.

Government ownership of 25% of the nation's industry.

Government ownership of a thousand non-taxpaying corporations (competing with private business, at a cost to taxpayers of $40 billion per year).

Government ownership of one-third (minimum) of every salary and wage dollar earned.

Government ownership of every American boy for two years.

It seems only logical that Government ownership of *all* of our precious airspace should prevail—Grand Canyons notwithstanding.

IRATE TAXPAYER

Joint Effort Adapter

As a subscriber to AVIATION WEEK, I have come to depend on your extremely wide, accurate coverage and the promptness with which you report on new developments.

In connection with this, it has been noted that in your issue of April 8, p. 85, a picture and article ("Adapter Converts Boom to Drogue") spoke of an adapter which is used to make possible the fueling of probe equipped fighters by boom tankers. This article mentions that the adapter was a joint development of WADC and the Schulz Tool Mfg. Co.

As far as the project was concerned, it actually was a cooperative development between the Power Plant Laboratory of WADC—primarily Mr. E. Stein, and Hewitt-Robins Incorporated, Buffalo, through contacts maintained by the writer. The cooperation extended over the refinement of the concept to an actual item, the production of the first unit, observation of tests through photographs and design and production of new non-standard types of hose to withstand the actual service.

We would appreciate, if possible, any action you could take to remove this impression, or at least to give us partial credit for the work which was done.

C. J. DAIGLER, Manager
Aircraft Products
Hewitt Rubber Division
Hewitt-Robins, Inc.
Buffalo, N. Y.

Aviation Week welcomes the opinion of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, Aviation Week, 330 W. 42nd St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.

'See, and Be Seen'

The casual reader reviewing the recent high level proposals to establish a greater degree of control over flight operations, primarily in the interest of safety and efficiency, gets the immediate impression that such measures will practically eliminate the threat of mid-air collisions.

Reliance on the "see and be seen" principle has failed to prevent mid-air collisions in the past, and is completely unworkable with the introduction of really high speed aircraft. So, the development of ATC procedures compatible with the performance of modern aircraft is a natural step.

But this is by no means the final answer to the collision problem, as there will always be conflicts between controlled IFR traffic and uncontrolled VFR traffic at lower altitudes and in clear weather.

Certain types of flights must be conducted under visual flight rules—demonstration, various training and check flights, agricultural, factory acceptance, routine test, certification and experimental. In addition, a vast amount of private and business flying will be conducted on an uncontrolled basis. It is impossible to confine these operations to off airways areas in every case. Almost every local military flying area in the northeast, for example, overlaps heavily traveled airways. Severely limiting such areas, or establishing additional restricted areas is not an acceptable solution.

This problem of conflict between controlled and uncontrolled traffic will always exist to some degree. Therefore, a very reasonable alternative is to design cockpits so as to permit unrestricted visibility. As every DC-3 pilot has learned, the pilot in the left seat is completely blind in a right turn, not being able to see through the top of the fuselage. Have we learned a lesson from the DC-3? Not a single modern civil transport here or abroad has adequate vision to the rear and overhead, from either seat. Admittedly, the newer types have superior vision through a limited arc, but in a turn are as blind as the DC-3. In addition to the currently operated types, newer models such as the Boeing 707, Britannia, Caravelle, Convair 880, Comet, Douglas DC-8, Electra and Friendship all suffer from this design deficiency. The aircraft manufacturers are not solely to blame. The ALPA and airline management are equally responsible, as both groups establish or approve transport requirements and specifications.

On the other hand, this visibility limitation has been overcome on practically all military types. The approaches vary but the results are the same. Only a few examples are necessary—the Douglas B-26 and A3D, Martin B-57, Lockheed P2V and North American AJ. Even the Fairchild C-119 and Douglas C-124 are provided with glass panels overhead.

Performance compromises apparently were not necessary to achieve good visibility. Neither design nor structural difficulties were insurmountable. Could not a scaled-up A3D cockpit have been incorporated in the DC-8 series?

Let's be consistent—unless potential hazards are removed at the source, the finest ATC system in existence is only a partial solution.

MAJOR HOWARD L. NASLUND, USAF
Washington, D. C.

Stub Meter Credit

I wish to comment on James S. Arnold's letter to the editor on the Stub Meter published in your issue of May 6 (p. 154). Mr. Arnold stated that he was pleased to see Convair take the leadership in making the Stub Meter a specific purpose production line testing instrument. Having been closely associated with the development of Convair's version of the Stub Meter and the numerous techniques developed to make it a usable production line instrument I would like to add the following credits.

The work praised by Mr. Arnold was done in the Electrical and Structural Test Groups at the Fort Worth plant of Convair Division of General Dynamics Corp. C. E. Horn developed the circuitry and T. G. Bogle developed the production inspection techniques. Tommy Bogle is now establishing a national reputation in being able to aid other aircraft manufacturers with their problems in inspecting adhesively bonded structures.

RUDOLPH A. DVORAK
Assistant Project Engineer
B-58 Project Office
Fort Worth, Tex.

for Navy's record-breaking ZPG-2...

Flight Control System—by Sperry

On a single flight recently, a Navy ZPG-2 airship remained aloft more than 264 hours (old record: 200 hours), flew 8,216 miles to a new distance marker (old record: 6,998 miles) and became the first aircraft to fly from the U.S. to Europe and back without refueling.

On this historic flight a Sperry A-12 Flight Control System also established a record. Its amplifier remained in constant operation throughout the entire 11 days of the flight—by far the longest period recorded for an automatic pilot—while the entire A-12 system performed perfectly and required no maintenance.

Strategic mission of the ZPG-class airships—airborne early warning and anti-sub warfare—puts a premium on precise flight control, a job that Sperry systems carry out reliably. In addition to reducing pilot fatigue, the A-12 Flight Control System automatically guides the airships smoothly and accurately on their exact courses, even in rough weather.

R. H. WAGNER, Engineering Department Head in our Aeronautical Equipment Division, has been closely associated with the development and application of the A-12 for fixed-wing aircraft as well as helicopters and airships.

Today thousands of Sperry systems are supplying safe, efficient automatic control for every kind of aircraft—from attack and strategic bombers to business planes and helicopters. No matter what your flight control problem is, Sperry engineers can help you find the right answer. Write our Aeronautical Equipment Division.

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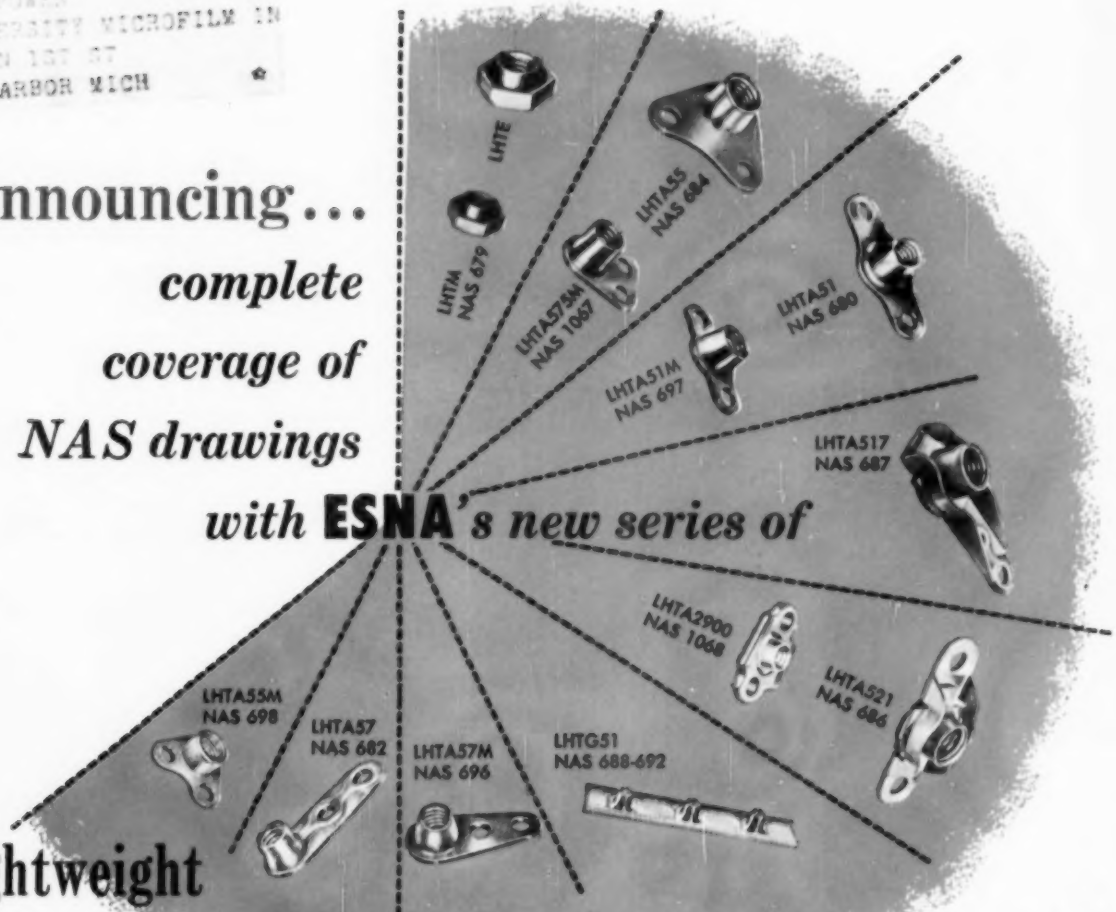

lightweight all-metal counterbored miniature self-locking nuts

Have you analyzed the structural design advantages and weight-saving possibilities offered by ESNA's AN approved versions of the new NAS low-height, lightweight, counterbored types of self-locking nuts?

For example, there is ESNA's LHTM-TE and LHTA51 series for structural applications which conform to NAS 679-695 drawings for low-height counterbored locknuts. These parts meet the tensile, vibration, twist- and push-out requirements of MIL-N-25027 (ASG), performing satisfactorily at temperatures up to 550° F; they also meet AN-N-5 and AN-N-10 tensile specifications and are dimensionally interchangeable with AN363, 364, 365, 366 parts. These nuts combine high strength with lightweight and reduced height; the counterbored base eliminates use of shims to keep threads out of bearing. Extra weight savings can be obtained by using them with new 160,000 psi short thread length NAS bolts.

Now, to meet the increasingly severe space limitations of new missile and avionic designs, ESNA announces the availability of a full line of NAS miniature, counterbored self-locking nuts conforming to NAS 696, 697, 698 drawings. All of these new Elastic Stop nuts use ESNA's AN approved offset crown locking device which exerts locking torque radially and elastically to assure vibration-proof tightness and extended re-usability.

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